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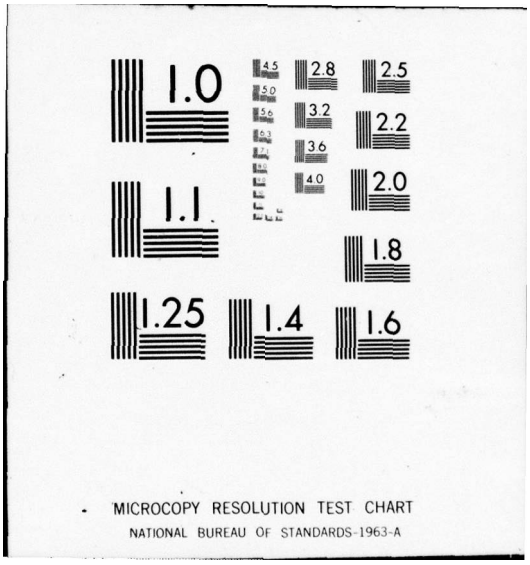
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FRANK J. SEILER RESEARCH LABORATORY

FJSRL TECHNICAL REPORT-77-0005
APRIL 1977

THE USE OF BIOFEEDBACK IN ANXIETY MANAGEMENT. TRAINING AND ITS EFFECTS ON SCHOLASTIC PERFORMANCE

PROJECT 2303

AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE

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In a series of experiments, high and low anxious academically deficient cadets at the Air Force Academy received a program in Anxiety Management (AM training which utilized biofeedback techniques, or a more traditional Study Habits Development (SHD) program, or a combined AM/SHD program. The Anxiety Management program consisted of 9, 20 minute relaxation sessions. The Study Habits Development program was 5 lessons long. All subjects receiving Anxiety Management training significantly reduced electromyograph (EMG) anxiety/tension level.

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High anxious subjects in the AM group showed significantly more academic improvement than a demand control group and high anxious subjects in the SHD group. Low anxious subjects showed significantly greater improvement after Study Habits training. A six month follow-up revealed that AM group subjects were able to sustain the gains in relaxation as measured by EMG level, however, the relative improvement in academic performance evidenced by high anxious subjects in this group was not sustained. The results suggest that Anxiety Management training is successful in reducing anxiety/tension level for high anxious subjects and that short term performance gains can be realized. However, follow-on training will be required if the short term performance improvement is to become long lasting.

THE USE OF BIOFEEDBACK IN ANXIETY MANAGEMENT. TRAINING AND ITS EFFECTS ON SCHOLASTIC PERFORMANCE

By

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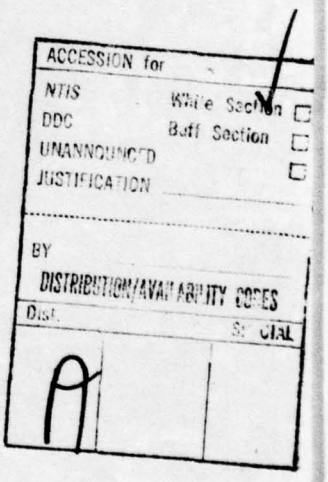

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APRIL 1977

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FOREWARD

This report was prepared by the Department of Behavioral Sciences and Leadership, United States Air Force Academy, Colorado. The research described herein was sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command, United States Air Force Academy, Colorado, under Project 7903, Chemical Synthesis and Characterization; Work Unit 7903-03-78, Biofeedback Techniques in Stress Management Training and its Effects on Scholastic Performance.

This report covers work conducted from August 1975 to June 1976. Biofeedback training was accomplished by using research equipment and facilities of the Department of Behavioral Sciences and Leadership, United States Air Force Academy, Colorado. The authors are indebted to Sergeants Dale Schimmel and Steven Hyatt for their technical support.

A review of the Defense Documentation Center (DDC) files revealed that there are no government or industrial reports in the system which deal with biofeedback training or any other program related to the management of psychologically induced stress. Therefore, the introduction to this study devotes considerable space to background material regarding psychological stress and anxiety, and how it may be reduced with biofeedback training and/or other kinds of programs.

This manuscript was released by the author for publication in April 1977. This technical report has been reviewed and approved.

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ABSTRACT

In a series of experiments, high and low anxious academically deficient cadets at the Air Force Academy received a program in Anxiety Management (AM) training which utilized biofeedback techniques, or a more traditional Study Habits Development (SHD) program, or a combined AM/SHD program. The Anxiety Management program consisted of 9, 20 minute relaxation sessions. The Study Habits Develcpment program was 5 lessons long. All subjects receiving Anxiety Management training significantly reduced electromyograph (EMG) anxiety/tension level. High anxious subjects in the AM group showed significantly more academic imporvement than a demand control group and high anxious subjects in the SHD group. Low anxious subjects showed signifantly greater improvement after Study Habits training. A 6 month follow-up revealed that AM group subjects were able to sustain the gains in relaxation as measured by EMG level, however, the relative improvement in academic performance evidenced by high anxious subjects in this group was not sustained. The results suggest that Anxiety Management training is successful in reducing anxiety/tension level for high anxious subjects and that short term performance gains can be realized. However, follow-on training will be required if the short term performance improvement is to become long lasting.

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INTRODUCTION

There are many factors which interact to affect an individual's performance on a given task. These factors can be dichotomized into two types: task specific factors and task non-specific factors. Task specific factors are those which are directly related to a given task. For example, as a pilot turns on final approach to landing, his ability to successfully land the aircraft is affected by such things as flying experience, aircraft familiarity, and familiarization with the airfield. These factors are specific to the task of flying, and knowledge about and practice on these task specific factors affect the pilot's quality of performance. Thus, the more times a pilot lands his airplane on a familiar airfield, the more precise his landings should become. Experience tells us, however, that the next landing a pilot makes will not necessarily be better than his last. There is not a one-to-one correspondence between landing precision and practice on task specific material. On some days a pilot simply has problems landing, regardless of wind conditions, flying experience, etcetera. The pilot may be tired both physically and mentally, or he may simply lack motivation to land the aircraft with great precision. These factors as well as anxiety/tension and anything else which affects either the physiological or psychological well-being of the person, are classified as task non-specific, with respect to their effects on performance. Task non-specific factors are always present and always impact on performance, either positively or negatively, irrespective of the nature of the task. Thus, it is clear that a person's performance on a task is simultaneously

affected by both task specific and task non-specific factors. This is true for all tasks, whether they are psychomotor skill tasks, such as flying an airplane, or cognitive tasks, such as memorizing the dates and locations of all of the battles fought in the Civil War.

When performance is substandard, it is generally assumed that some task specific factor has not been practiced enough. The usual remedy is to require additional training on the identified factor until performance improves. Sometimes, however, performance does not improve as a result of additional practice. If improvement in performance is not evident after additional practice, this may suggest that the originally observed performance deficit was caused by a non-specific task factor. This is tacitly recognized when "lack of motivation" is used to account for substandard performance. Unfortunately, when task non-specific factors are implicated in substandard performance, they are generally referenced vaguely, apparently in an attempt to explain away the deficient performance. No systematic program is provided to the individual to help him overcome the deficiency. This is not due to any lack of concern or compassion for the individual; it merely reflects a lack of knowledge about how to help someone overcome poor performance resulting from a task non-specific factor. Little research has been done which attempts to identify the ingredients needed to design a corrective program for substandard performance when it is principally due to the influence of a task non-specific factor.

One task non-specific factor affecting performance which appears to be particularly pervasive is anxiety. Anxiety affects performance on both

psychomotor and cognitive tasks, easy and difficult tasks, new or well-practiced tasks. Unfortunately, with the exception of clinical problems resulting from anxiety, little research has been reported which identifies coping strategies a person can employ to deal with anxiety in a performance situation. The purpose of the research reported here was to develop and evaluate the effectiveness of a program designed to combat the task non-specific effects of anxiety. Specifically, a program was developed to aid a student in combating the deleterious effects of test anxiety in an academic environment. Since it is assumed that the effects of anxiety are general in nature, it would seem reasonable to expect that any improvement in performance resulting from the anxiety management program presented in this report would be applicable to other task situations, such as piloting an aircraft.

Anxiety Defined

Even though everyone has experienced "anxiety" in his or her own life, the exact nature of the "anxiety" reaction is not completely understood nor well defined. Some psychologists say anxiety is the reaction to a perceived environmental stressor. If a stranger walks up, points a gun at you and demands your wallet, you would no doubt experience fear. According to Hebb (1966), this situation would induce fear and not anxiety since a real environment stressor is present. If while walking down the street you believe that you are being followed by someone, you would also experience fear. Since in this situation it has not been determined whether or not you were actually being followed, there is no

objective basis for fear. Therefore, this "fear" response is labeled an anxiety reaction and not fear, since it originates within the person himself and not from a real environmental stressor.

In some ways it would appear to be a false dichotomy to distinguish between anxiety and fear based on the real or perceived threat in a given situation. On both a cognitive, psychological level and on a physiological level a constellation of changes takes place within the person experiencing stress; many of these things are the same for both fear and anxiety. Therefore, for the purpose of this report, anxiety will be viewed as a general response to either a real or a perceived stressor which involves both psychological and physiological changes to counter the environmentally or psychologically imposed stress.

Performance and Level of Anxiety

Understanding the relationship between anxiety and performance is critical to the design of a program intending to minimize the negative consequences of anxiety on performance. Since anxiety is often equated with physiological arousal level (Appley and Trumbull, 1967; Lazarus, 1966), some idea of the relationship between performance and anxiety can be seen by reviewing the literature on arousal and performance. The nature of the relationship between anxiety and performance is complex, and it has been under investigation since as early as 1908. In a comparative study using laboratory animals, Yerkes and Dodson (1908) observed a consistent relationship between tension level and quality of performance. More recently, other

investigators (Court, 1942; Duffy, 1957, 1962; Hebb, 1966; and Malmo, 1959) have proposed that performance quality increases monotonically with arousal level up to an optimal point, then performance decreases as tension level continues to increase. This inverted-U relationship between performance and arousal has been shown to hold for psychomotor skill tasks (Eason and Branks, 1973; Martens and Landers, 1970), such as learning an athletic skill, and for cognitive tasks (Eason and Branks, 1973) such as memorizing an airplane preflight check list. The exact shape of the inverted-U relationship appears to change to some degree as a function of task difficulty. Bourne and Ekstrand (1973) suggest that for easy tasks, optimal performance is achieved with a moderately high level of arousal. Moderately difficult tasks are best performed with moderate arousal. Complex tasks are performed best with a lower level of arousal (see figure 1).

What constitutes low, moderate, or high arousal is a point of contention. This is probably due to the fact that the nominal level of arousal varies widely from individual to individual (Cameron, 1944) and thus what is low arousal for one person may be high for another. Given this situation, it would appear that one reason for differences in performance is due to the tendency of people to maintain a relatively constant arousal level without regard for task difficulty, (Lindgren, Byrne, and Petrinovick, 1967). Apparently, under normal conditions, people do not exercise sufficient conscious control over arousal level to moderate their level of performance.

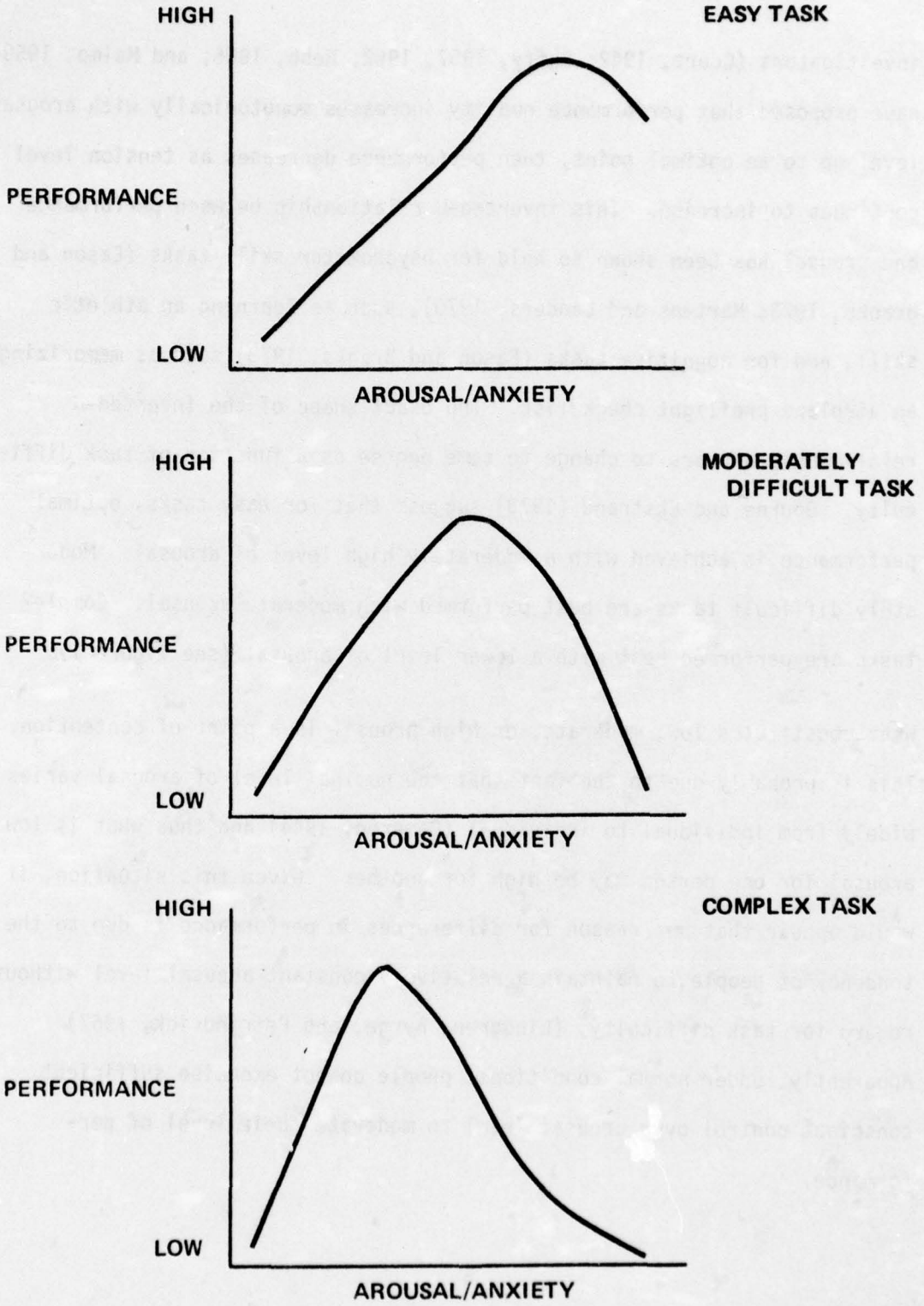

FIGURE 1. RELATIONSHIP BETWEEN PERFORMANCE AND AROUSAL/ANXIETY LEVEL AS A FUNCTION OF TASK DIFFICULTY.

Debilitating Effects of High Anxiety/Arousal

As noted earlier, the inverted-U relationship indicates that high levels of arousal may have a deleterious effect on performance. At extremely high levels, these effects can even be debilitating. The negative consequences of anxiety/arousal are frequently observed in an emergency situation, such as when a person is trapped in a fire. As a person becomes aware of a fire in his apartment he may become confused and disorganized and make no attempt to get out of the building. He may wander about aimlessly or search for something of little immediate value such as a shoe, unwilling to leave until it is found. Apparently the intensity of arousal created by the environmental stressor (fire) is severe enough to impair or block the processes that control organized behavior, and thus functionally incapacitate the individual.

Disorganization, confusion and the inability to act, however, are not the only consequences of intense arousal. Hans Selye (1973) has indicated that at the physiological level the body reacts to stress by making both a general stereotypic response and a stressor specific response. The general response occurs regardless of the specific stressor involved. Selye calls this general stress response the General Adaptation Syndrome (GAS). After injecting toxic gland preparations in various tissues, Selye observed an enlargement in the adrenal glands, thymicolymphatic shrinkage, and gastrointestinal ulceration. These changes define the GAS and highlight the general physiological consequences of heighten arousal.

The GAS can be activated by cognitive, psychological stress as well as physiological stress. Frequently, when a person addresses an audience, he experiences sweaty palms and a "cotton" mouth. These are signs that the person feels stressed. However, since the stress is not objective in the sense that the speaker could not reasonably expect physical harm for his performance, it is based on his prior learning and perception of the situation. The person is making an anxiety reaction in the classic sense of the word. The induced anxiety may then produce physiological consequences. This was dramatically demonstrated by Brady (1958). Brady subjected four rhesus monkeys to the same environmental stressor (shock); however, only two monkeys were provided with a response key which, if used, would prevent shock for all four monkeys. Even though all the monkeys were exposed to the same environmental stressor (i.e. the same number of shocks), only the "executive" monkeys who could control the environmental stressor developed severe gastrointestinal ulceration. Apparently, the anxiety produced by having control over the shock was enough of a psychological stressor to enhance the development of gastrointestinal ulcers in this situation.

The physiological consequences of heightened anxiety may have even more profound effects than those proposed by Selye or demonstrated by Brady. Galluscio, Eggleston, Koehn, Garland, Schmid, and Yasuhara (1974) in a study using laboratory rats found significant changes in brain morphology for those animals who performed an "executive" function. There was a significant reduction in cortical mass in the region primarily responsible for vision and enlargment in the hypothalmic region for the "executive"

animals relative to other animals who received the same number of shocks (environmental stressor). Clearly, the changes in brain morphology were the result of psychological and not merely environmental stress. This research indicates the potential long lasting consequences of chronic high arousal/anxiety. Recognizing these potential consequences, it would seem most appropriate to design a program to aid people in coping with and minimizing the consequences of heightened anxiety/arousal.

A Theoretical Model for Anxiety/Arousal Reduction

The Brady "executive monkey" study indicated that giving the subject control over the stressor stimulus increases the severity of its physiological effect. More recent research has shown that the relationship between stress control and stress trauma are not as simplistic as the Brady study would suggest. Weiss, in a comprehensive series of studies (Weiss, 1968, 1971, 1972), has demonstrated that instrumental control over stress, which he refers to as "coping responses", may actually reduce stress trauma under certain conditions. Weiss (1972) suggested that the "psychological" component of stress measured by gastric ulceration is determined by two related factors: the number of responses made to cope with the stress and the relevance of the feedback resulting from the responses. Relevant feedback refers to any response contingent stimulus which when presented to the organism will provide information about his performance. This information can be used to modify performance. In the Weiss model, ulceration increases as the number of coping responses increase and relevancy of feedback decreases. Therefore, maximum ulcer-

ation would be associated with conditions that produce high response rates and poor or negative feedback.

Weiss supports his model with an impressive series of comparative research (Weiss, 1968, 1971, 1972). When relevant feedback was provided and the response rate low, Weiss (1972) demonstrated that less ulceration resulted from adding psychological stress to the environmental (shock) stressor. This is contrary to the Brady (1958) and Galluscio et al. studies where more physiological damage resulted with the addition of psychological stress; however, in these two latter studies, response rate was high and feedback relevancy was very low. From the Weiss model, it would be predicted that this situation would in fact result in ulceration, just as was shown to the case. The Weiss model therefore is capable of resolving apparently contradictory results. It would also suggest that Brady was incorrect in his interpretation that simply exercising control over a stressor necessarily heightens the intensity of the situation. The inadequacy of this position is further evidenced from research which has been reported by investigators using human subjects. Geer, Davidson and Gatchel (1970) used shock to induce stress in a reaction time (RT) experiment. The subjects were instructed to make an RT response when they felt a shock that remained on for 6 seconds. After this experience, half of the subjects were told that the shock duration would be reduced to 3 seconds, contingent upon improvement in RT performance. The rest of the subjects were simply informed that for the second phase of the experiment, shock duration would be cut in half. Thus both groups of subjects experienced the same amount of shock stress, but the experimental subjects perceived that they had instrumental control over the

shock. The subjects who had perceived control over the shock stressor decreased RT, increased their tolerance to shock induced pain, and lowered the galvanic skin response (GSR). This was not the case for the other subjects. It is important to note that actual control over shock duration was not involved in this experiment. Arousal level, as measured by GSR, was reduced as a result of the subject's perceived control. Since shock duration was decreased concomitantly with RT decreases for these subjects, the reduced shock would serve as feedback to reinforce their faster RT response rate. This highly relevant feedback could be the crucial variable in determining the psychological intensity of stress perceived by a person.

Additional support for the importance of relevant feedback can also be seen in a study by Haggard (1943). Subjects who recognized the contingency between shock and a free association stimulus which served as a trigger for shock onset showed lower arousal than subjects who were unaware of this contingency. Knowledge of the trigger word apparently served as relevant feedback.

Anxiety Management Program Design Considerations

The effect of anxiety on performance is indeed significant. In some situations the effect is positive; however, in far more situations anxiety interferes with performance. This interference is generally a product of heightened anxiety/arousal rather than the result of too little arousal anxiety. Thus, it would seem a program designed to minimize the

task non-specific effect of anxiety should incorporate procedures which can aid a person in reducing his anxiety level. The Weiss model suggests that at least the physiological effects of anxiety/arousal can be minimized by increasing relevant feedback or by reducing response frequency, or by doing both simultaneously. This may also be true for psychological effects of anxiety. Since a given task might dictate a specific response rate, it would be impractical to try and control response rate in an anxiety reduction program. Relevant feedback, on the other hand, can be controlled and therefore the authors directed their attention to feedback and how it might be incorporated in an anxiety reduction program. An emerging technology referred to as biofeedback appeared to provide a suitable technique for providing relevant feedback to aid a person in the fight against anxiety.

Biofeedback Training. Everyone uses biofeedback in the normal course of life. For instance, when a person climbs a flight of stairs he usually becomes aware of a change in his breathing rate. This is biofeedback. In general, biofeedback is the process by which a person acquires instantaneous information about his physiological condition.

Through experience everyone has learned to use biofeedback as a means of becoming aware of his physiological condition. The information acquired by biofeedback is then used to determine whether or not an adjustment in activity level needs to be made. For instance, in the example of climbing

stairs presented above, if a person is in poor physical condition his respiration rate will increase markedly. This "biofeedback" warns the person that he needs to rest before engaging in further activity. In most instances, however, changes in internal functions are so subtle that an individual is usually unaware of their actions. Through recent technological advances, it is now possible to detect these subtle changes and to immediately feed this information back to a person. It is this procedure of using electronic equipment to detect and feedback to its user relevant physiological information that is usually referred to by the term biofeedback.

Biofeedback equipment uses a transducer or an electrode which detects and transmits an electrical potential. This signal is then amplified and transformed to useable form; that is, it is changed into something readily understandable by any human being. For example, a transducer may be placed on a finger to detect blood pressure. The blood pressure signal is amplified and then used to drive a light which changes in color from green to red as changes in blood pressure occur. By converting the signal generated by blood pressure in this manner, a person is now in the position to utilize this information which was formerly unavailable to him.

The purpose of biofeedback training is to teach a person to become aware of physiological states and to more efficiently use his own internal

feedback mechanisms in order to maintain or improve both his physiological and psychological health. The first step in this learning process is to become aware of subtle body functions. Once this is achieved, a person can learn to control, within limits, physiological changes in mechanisms involved in a given physiological function. Indeed, it has been demonstrated that a person can become aware of and exercise control over many internal processes previously considered involuntary and controllable from an external source only by medical or chemical intervention (Scott, Blanchard, Edmanson and Young, 1973).

Biofeedback has been used successfully to teach control over a number of body processes (Medical World News, 1973). Armed with this knowledge, many investigators have recently applied biofeedback training to both clinical and medical problems (Bleecker and Engel, 1973; Budzynski and Stoyva, 1972; Engel, Nikoomanesh, and Schuster, 1974; Wickramasekera, 1974).

Budzynski, Stoyva, Adler and Mullaney (1972) investigated the efficacy of electromyographic biofeedback (EMG) in relieving tension headaches. Their results indicated that subjects who received EMG feedback had significantly less headache activity than subjects who did not receive feedback. Four of six patients in the biofeedback group reduced their frequency of tension headache to almost zero. Adler and Adler (1976) in a five year follow-up of headache patients who were treated with EMG and/or temperature feedback reported success in reducing headache frequency to less that 25% of the original frequency for a five year period. Eighty-eight percent of the tension

headache patients, 81% of the migraine patients and 60% of the mixed and cluster headache patients evidenced this improvement, which was substantially the same proportion of patients showing improvement at the end of EMG training. It appears that gains made from biofeedback training can be long lasting. Similar improvement has been reported from studies that used blood pressure feedback to alleviate symptoms of essential hypertension (Benson, Shapiro, Tursky and Schwartz, 1971; Elder, Ruiz and Deabler, 1973).

Although the etiology for migraines and other headaches is not clear, it is generally believed that excessive anxiety is frequently involved in headache onset. Since biofeedback training has proven to be successful in dealing with this anxiety related problem, perhaps biofeedback training would be an appropriate prescription for other anxiety disorders, such as test anxiety.

Only one study has been reported which provided biofeedback training for test anxious students. Garrett and Silver (1975) trained students in alpha feedback, EMG feedback, or both alpha and EMG feedback. By the end of training, subjects in all three groups reported feeling less test anxiety. The authors pointed out, however, that there was no significant improvement in semester grade point average. Thus, even though the subjects felt better, biofeedback training apparently did not materially affect their performance.

The idea of using biofeedback training should not be dismissed simply because one study failed to demonstrate its utility beyond that of providing a catharsis for its user. Lack of improvement in performance could have resulted for a variety of reasons. It may be that to be effective a program must include something in addition to biofeedback training. Or, as Goldfried and Trier (1975) suggest, benefits from biofeedback may not be manifest until this training has been integrated into the person's life style. Thus, perhaps Garrett and Silver simply collected their performance data at the wrong time. Obviously, more research is needed before the potential benefits of biofeedback training on test anxiety can be ascertained.

Progressive Relaxation Training. Jacobson (1938) observed in many patients suffering from chronic anxiety an accompanying high level of muscle tension. As a result of this observation Jacobson postulated that muscle relaxation was the opposite of anxiety and thus set out to develop a muscle relaxation procedure as a treatment for anxiety. This program involved a systematic progressive relaxation of specific muscle groups until total relaxation was achieved. Having patients alternately tense and relax specific muscle groups appeared to increase the patient's awareness of tension. At the same time, the patient appeared to gain control over his anxiety. Jacobson observed that his patients appeared more relaxed and less anxious. The patients themselves reported being less anxious and able to function more effectively. It would appear that a reduction in the anxiety reaction can be achieved by using the

Progressive Relaxation Training program which therefore provides an alternative means to biofeedback training for dealing with test anxiety.

Systematic Desensitization. A phobia such as a fear of high places (acrophobia) or strangers (xenophobia) provides the clearest example of a severe anxiety reaction. Borrowing from behavior therapy, Wolpe (1958) devised a theory specifically to deal with phobic reactions and other clinical problems which stem from anxiety. This theory, the Theory of Reciprocal Inhibition, states that there are a number of responses available to the individual which when present seem to inhibit anxiety. Wolpe determined that the most efficient and effective response for inhibiting anxiety was the relaxation response previously proposed by Jacobson; therefore, this response was included in his theory. Specifically, Reciprocal Inhibition Theory proposed that the relaxation response and anxiety were mutually exclusive events, with it being physiologically impossible for both to occur in a person at the same time. From this theoretical notion, Wolpe designed a clinical treatment program which introduced relaxation to the patient as a replacement response to anxiety. Initially, the patient would be trained to relax, using a modified Jacobson procedure. Then Wolpe introduced a procedure called Systematic Desensitization. Systematic Desensitization called for the visualization of specific scenes from the patient's past. These scenes were arranged in a hierarchy according to the amount of anxiety each produced in the patient. After the patient was relaxed, Wolpe would ask him to imagine a scene, beginning with the least anxiety provoking scene and then progressing sequentially through each scene of the hierarchy. Whenever anxiety became unbearable for the

patient, he was instructed to switch off the image and return to a relaxed state. This procedure continued until the person was capable of remaining relaxed while imagining the most anxiety provoking scene. Using the Systematic Desensitization approach, many clinical therapists have had success in eliminating phobias and other clinical problems associated with high anxiety.

Autogenic Training. Schultz and Luthe (1959) proposed an alternate approach to Jacobson's Progressive Relaxation as a means for inducing the relaxation response. In this approach, the patient is asked to repeat certain phrases, such as "My hands are warm and relaxed", or "My mind is calm and quiet", while he is relaxing. It is believed that by repeating autogenic phrases a person will be able to bring about the desired physiological changes to induce relaxation (Luthe, 1969). As Green, Green, Walter, Sargent and Meyer (1973) explain it, the idea of autogenic training is to have the person visualize, imagine and actually feel the change happening, physiologically. It is important to simply let the change occur; if one tries to make it happen this effort in itself will interfere with the production of relaxation. In comparing autogenic training with biofeedback training and a combined autogenic - biofeedback program, Sheridan, Boehm, Ward and Justen (1976) reported that subjects were able to change hand temperatures above a control level significantly better with autogenic training and with the combined autogenic biofeedback program than by using biofeedback by itself. Thus, it would appear that this type of training may be valuable for inducing changes in physiological processes related to anxiety.

A Program to Combat Test Anxiety

Biofeedback Training, Progressive Relaxation, Reciprocal Inhibition, and Autogenic Training are all reasonable programs to use in helping a person cope with anxiety. Progressive Relaxation, Reciprocal Inhibition, and Autogenic Training have a weakness, however, in that neither the client nor the therapist know the actual degree of relaxation being achieved by the client. A person may believe he is relaxed when, in fact, he is not. In all three of these methods, the trainer/therapist has only the subjective report of the client and his own observations from which to infer the extent of the client's relaxation. This is a hazardous situation since both subjective reports and trained observer observations can be incorrect. This situation can be minimized, however, by employing biofeedback. With feedback, an objective indicator of relaxation is readily available to both client and trainer. Therefore, Progressive Relaxation, Reciprocal Inhibition and Autogenic Training programs can be strengthened by including biofeedback.

Recognizing the advantages and limitations of each of the above mentioned programs, the authors elected to combine elements from all of them into a program specifically designed to deal with test anxiety. EMG biofeedback was central to the training since an objective measure of anxiety and its opposite, relaxation, seemed essential. Our aim was threefold: first, to make the student aware of his anxiety if he had been denying it; second, to teach him to control it; third,to demonstrate that he could maintain control over anxiety even in the presence of stress. It was hoped that by

the end of training each student will have devised a coping strategy for dealing with test anxiety, using elements of the provided Anxiety Management training program.

Experiment I was designed based on the belief that if a student suffers from test anxiety, his performance cannot be improved significantly unless he learns how to overcome this problem. Therefore, in this experiment, high anxious students were given either a program specifically for test anxiety or a more general study habit development program. It was expected that the high anxious students receiving the test anxiety program would show academic improvement while their counterparts receiving the study habits program would not.

EXPERIMENT I

Method

Subjects. The subjects were 54 male cadets who were in their third year at the United States Air Force Academy. All subjects were volunteers selected on the basis of academic deficiency. The grade point average (GPA) for each cadet was below 2.0 (4 point scale) for work completed the semester prior to this experiment; their mean GPA for all previous work was 2.24. Forty-four of the subjects took the IPAT Self Analysis Anxiety Scale and were dichotomized into high and low anxiety groups. The median score for low anxious subjects was at the 8th percentile for college males (range 1 - 18% ile) while the median score for the high anxious

group was at the 34th percentile (range: 21 - 96% ile). The remaining 10 subjects served as a Demand Control Group and did not take the IPAT Self Analysis Scale.

Apparatus. Electromyographic feedback (EMG) was provided by a Bio-feedback Systems, Inc. model B-1 unit. EMG activity was picked up by electrodes (Bio-feedback Systems, Inc.) attached to the frontal muscle group. The B-1 unit filtered the EMG signal, using a 100 Hz-1000 Hz bandpass. Auditory feedback was provided to the subject in terms of a train of clicks presented through a stereo headset. A white noise (Hewlett Packard White Noise Generator, model 1432) environment background was also presented through the headset (43 dB $\pm$ 3 dB). Stress management training was accomplished in an acoustic chamber. Voice communication was maintained between experimenter and subject by a Rheem microphone which was connected directly to the earphones.

Procedure. A double blind technique was used to randomly assign and equally divide subjects with high IPAT anxiety scores to the Anxiety Management (AM) group, and to the Study Habits Development (SHD) group. Twenty-two subjects with low IPAT anxiety scores were divided in a similar fashion.

Each time a subject in the AM group entered the laboratory, he was instructed to complete one of eight forms of the IPAT 8 parallel Form Anxiety test. (All 8 forms were completed once before any given form

was administered a second time). Upon completing this test (approximately 10 minutes), the subject was seated in a comfortable chair in the dimly illuminated acoustic chamber. His forehead was cleaned with isopropyl alcohol and the electrode strip was placed on his forehead. The electrode strip was attached with the ground (center) electrode placed one inch above the nasion and the recording electrodes located in a straight line 5.08 cm to either side of the center electrode. If electrode impedance exceeded 10k ohms, the electrodes were removed and refitted until impedance was less than 10k ohms. The subject was instructed to relax and not to make any unnecessary body movements in order to minimize electrical artifact in the EMG recordings. The subject put on the earphones and was then ready to begin an Anxiety Management session.

Data were collected from outside the acoustic chamber at an adjacent experimenter station. The EMG equipment was calibrated before and after each training session. The EMG equipment was programmed to alternate a 64 second data collection period with a 20 second time out period which allowed the experimenter time to record the data. Using this format, baseline data were collected for two recording periods at the beginning and end of each session. The subject did not receive EMG feedback during baseline recording; however, the white noise environment was maintained. The 64/20 recording/time out format was also used to collect data throughout all feedback sessions. The experimenter gave instructions to the subject by a microphone system. The experimenter could see the subject at all times through a one-way mirror. If the subject appeared

drowsy, the experimenter would remind him to keep his eyes open and to follow all instructions.

Anxiety Management Training. AM sessions were approximately 20 minutes long. The total program consisted of 9 sessions, with two sessions scheduled per week per subject. Subjects were told that they would be trained how to relax and that this would help them perform better on examinations provided that they continued to study to the same extent as they had in the past.

The 9 sessions were divided into 3 blocks: relaxation training, autogenic training, and stress management training. At the beginning of Session 1, a 5 minute baseline reading was taken where the subject was simply told to sit quietly and relax. Then he was asked to tense and relax selected muscle groups for the remainder of the session. This training was continued for two sessions. No EMG feedback was provided in either of these sessions. Block II consisted of 3 sessions. EMG feedback was continuously provided and the subject was asked to repeat specific autogenic phrases (e.g. my arm is heavy) while relaxing selected muscle groups. The remaining 4 sessions were in block 3, stress management training. During the first 2 sessions in this block, continuous EMG feedback was provided while the subject was asked to imagine test related stress producing scenes. The subject was provided with a response button which, when depressed, illuminated a light at the experimenter's station. Each subject was instructed to depress the response button when the requested image had been formed. This provided the experimenter with a signal

indicating when to continue with the script. In the event that anxiety became unbearable from visualizing the imaginery scene, the subject was also instructed to use the response button. When this occurred, he was instructed to abort the image and to relax by repeating a provided autogenic phrase. The scenes were standardized across subjects; however, they were individualized to the extent that specific courses currently being taken by a subject were referenced. The third session in this block was identical to the first two except EMG feedback was faded out as the subject improved his performance. The final session was identical to the one preceding it except no EMG feedback was provided. This was done to reduce the subject's dependency on the EMG feedback signal and to increase his use of internal body cues to maintain a relaxed state, since body cues were all that would be available to the subject outside of the laboratory. Verbal feedback was continuously used to reinforce improvement in relaxation ability beginning with the third session. (Complete scripts for Anxiety Management Training are provided in Appendix A.)

A 3.0mv EMG level was established as the indicator of relaxation (Budzynski, personal communication, October 1974). If this criterion was not met by the completion of autogenic training, a personalized program utilizing relaxation producing imagery was employed. This personalized program continued until a 3.0mv EMG level or lower was reached or for 4 sessions, whichever occurred first. Then the subject proceeded to block 3, stress management training.

Nc one required the use of the personalized program. One subject in the AM group and three in the SHD group were forced to drop from the study due to conflicting commitments.

Study Habits Development Training (SHD). The subjects in this group received a 5 lesson program in study habits development. The 5-lesson SHD program focused on three main factors: 1) increasing study time and improving efficiency by employing a highly structured self modification program, 2) developing test taking skills, and 3) developing reading flexibility. Each subject met once a week with a USAFA faculty member to discuss his academic problems. The tutor would make specific proposals to help the subject better deal with the subject identified problem(s) and then he would discuss one of the SHD lessons. After answering questions about the lesson, the subject was instructed to incorporate the lesson material into his study program and to report his progress at the next weekly meeting. Each of the 5 sessions lasted approximately 30 minutes. As part of the program, the subject had to maintain a study log and a study break log. Both of these were reviewed weekly by the faculty tutor. (SHD lessons, a study log and a study break log are provided in Appendix B.)

Demand Control Group (DC) Subjects in this group met once a week for 5 weeks with one of his current course instructors to discuss the subject's academic progress. The instructor took a sincere interest in his problem(s) and provided general guidance, but the instructor did not present a structured study program.

Results

Anxiety Management Training. Pre and post-session EMG baseline levels were recorded while the subject was in a relaxed condition. Mean baseline EMG level prior to session one was 6.51mv/min for subjects with high IPAT Self Analysis scores (AMH group) and 3.85mv/min for subjects with low IPAT scores (AML group), or 45% lower than for the AMH subjects. Both AMH and AML subjects showed a mark reduction in pre-session baseline EMG level by session 5 (mean EMG level 1.70mv/min and 2.08mv/min, respectively). By the end of training pre-session EMG levels stabilized at 1.91mv/min for the AMH group and 1.64mv/min for the AML group, a 71% and a 57% respective improvement from initial EMG level. (see figure 2).

Similar reductions in EMG levels were noted when both mean session and mean post-session baseline readings were analyzed. Mean post-session baseline EMG levels were nearly at tonic level for both groups (AMH: 1.34mv/min, AML: 1.28mv/min., see figure 3 and 4).

Reduction in frontal muscle group tension as reflected by changes in pre-session EMG levels was significant over training sessions ($F(8.152)=7.03$, $p < .001$) for both high and low anxious subjects. No difference was found between the AMH and AML groups, and the anxiety group X EMG interaction was not significant. The same results were found when post session and mean session EMG data was compared over training sessions (see table 1).

IPAT 8 - Parallel Form Performance. Both a separate subtest score and a total test score were calculated for this test. Only the total test score

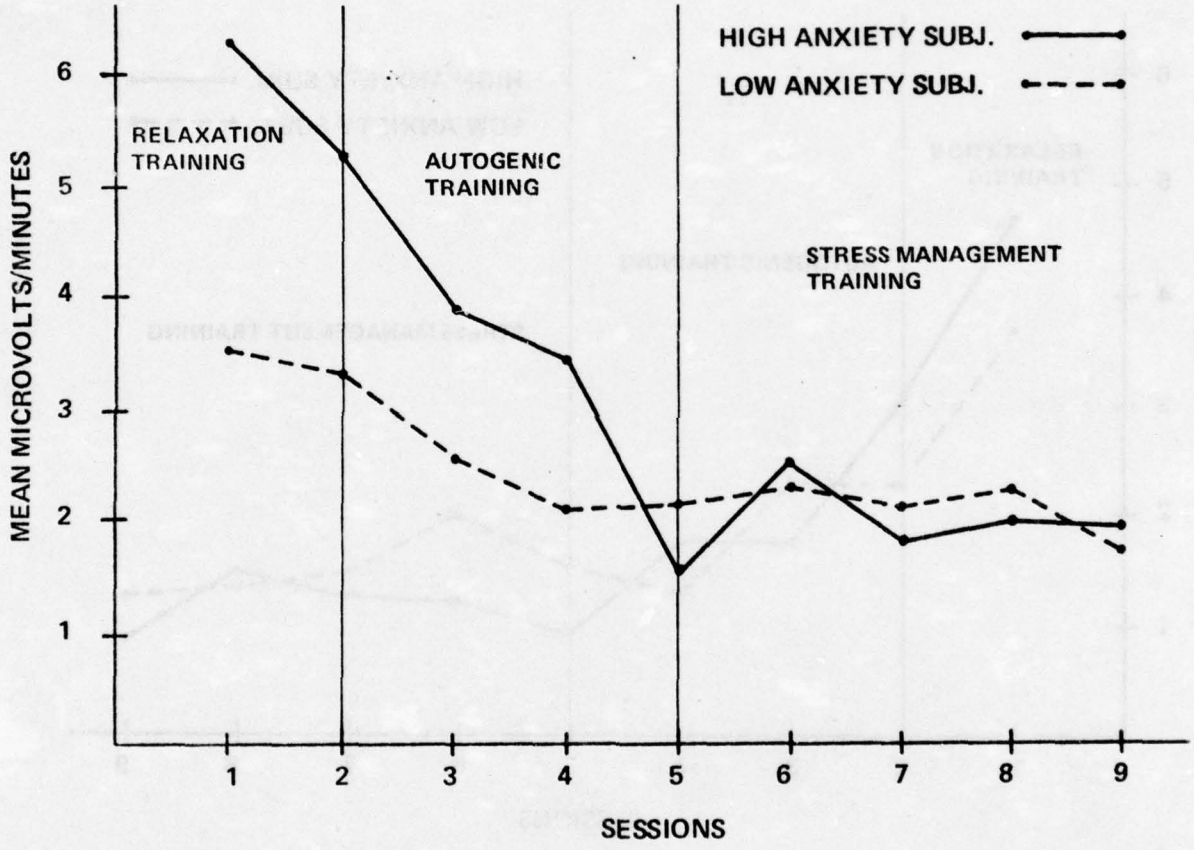

FIGURE 2. CHANGES IN PRESESSION BASELINE EMG (FRONTAL MUSCLE TENSION) LEVELS OVER ANXIETY MANAGEMENT TRAINING SESSIONS BY ANXIETY CONDITION (HI/LO).

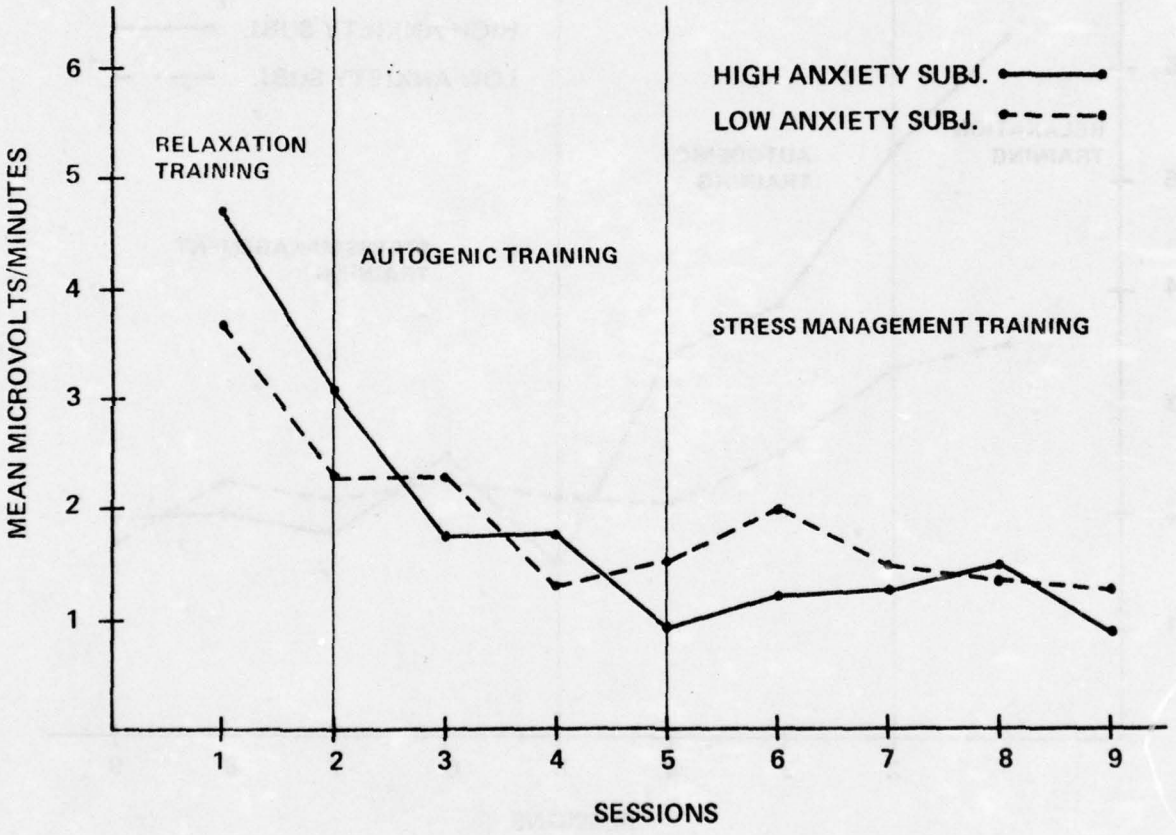

FIGURE 3. CHANGES IN POST-SESSION BASELINE EMG (FRONTAL MUSCLE TENSION) LEVELS OVER ANXIETY MANAGEMENT TRAINING SESSIONS BY ANXIETY CONDITION.

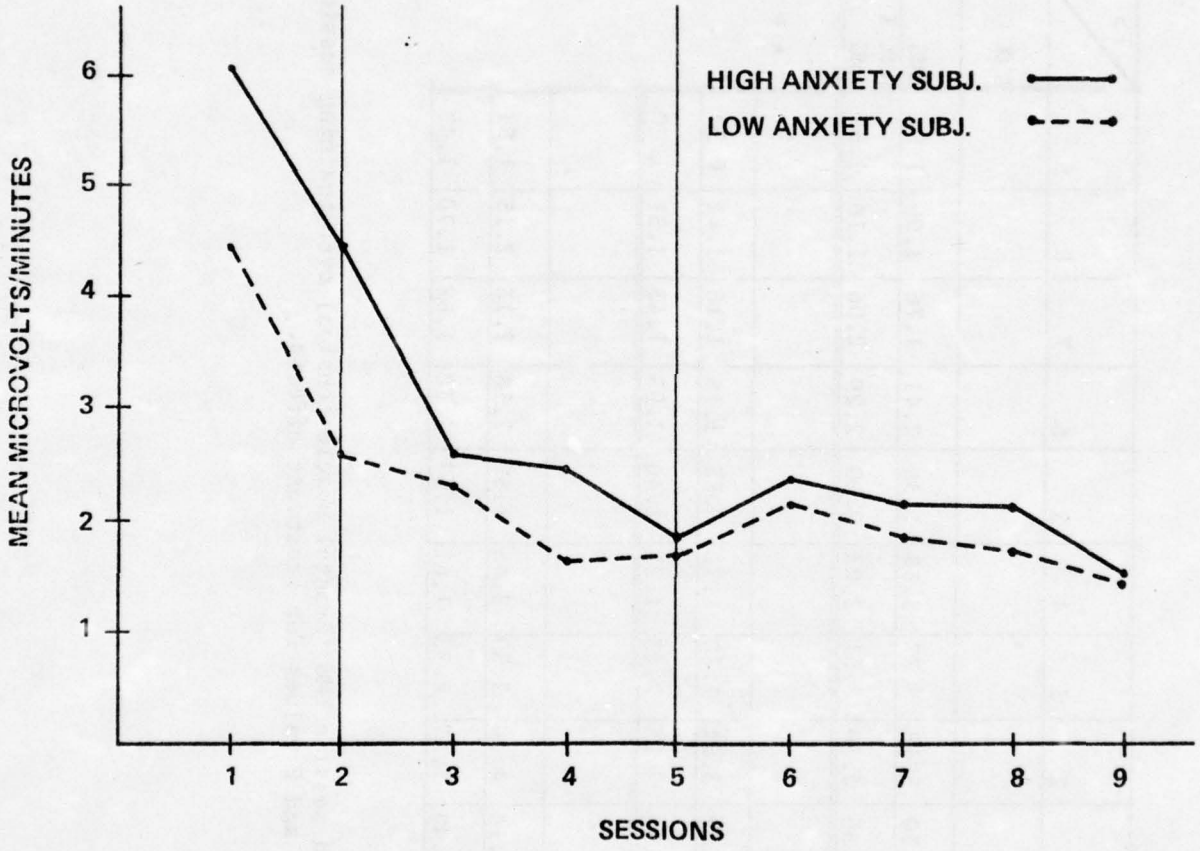

FIGURE 4. CHANGES IN MEAN SESSION EMG (FRONTAL MUSCLE TENSION) LEVELS OVER ANXIETY MANAGEMENT TRAINING SESSIONS BY ANXIETY CONDITION.

TABLE 1

Sessions / Conditions	1	2	3	4	5	6	7	8	9
Pre-Session EMG									
High Anxious	6.10	5.18	3.77	3.38	1.39	2.41	1.76	1.96	1.91
Low Anxious	3.36	3.30	2.51	2.03	2.09	2.29	2.06	2.16	1.64
Post-Session EMG									
High Anxious	4.52	3.04	1.70	1.71	0.85	1.18	1.18	1.42	0.90
Low Anxious	3.56	2.25	2.23	1.25	1.46	1.95	1.43	1.31	1.20
Mean Session EMG									
High Anxious	6.14	4.50	2.59	2.46	1.82	2.38	2.13	2.13	1.51
Low Anxious	4.48	2.57	2.33	1.61	1.67	2.18	1.82	1.70	1.43

FS	Pre-Session EMG	Post-Session EMG	Mean Session EMG
ANX	3.19	0.72	3.14
EMG	7.03*	6.67*	12.51*
ANX X EMG	1.39	0.60	1.17

* P < .001

Mean pre, post, and session EMG (Frontal muscle tension) over training sessions by subject anxiety (high/low) and F values for treatment effects.

data were analyzed; however, since inter-form reliability of the subtests is questionable due to the small number of questions on each subtest (Cattell and Scheier, 1973). A repeated measures ANOVA on this data revealed no significant change in self reported anxiety over the Anxiety Management training sessions for either high or low anxious subjects.

Nelson-Denny Reading Test Performance. Parallel forms (C and D) of the Nelson-Denny Reading Test (Brown, Nelson, and Denny, 1973) were administered pre and post-training to subjects in both the Anxiety Management and Study Habits Development groups. The Nelson-Denny is divided into two parts: Part I, Vocabulary; Part II, Reading Comprehension. Subjects were allowed 7-1/2 minutes for Part I and 15 minutes for Part II. Testing time was abbreviated from the normally allotted time as a means of increasing stress. Separate vocabulary and reading comprehension scores were calculated, along with a composite score which weighted both parts equally. All analyses were performed by using a repeated measures ANOVA on pre and post-training test scores. Improvement in vocabulary test performance from the pretest to post-test (mean correct 43.85 and 50.88 respectively) was significant ($F(1.32) = 27.27$, $p < .001$; however, there was no difference between the Anxiety Management and Study Habits Development groups or between high and low anxious subjects. A similar analysis of reading comprehension scores produced no significant comparisons. An analysis of the combined vocabulary and reading comprehension data was significant for change in test score regardless of the treatment condition or subject anxiety level. A complete description of the Nelson-Denny data can be found in table 2.

TABLE 2

Test / Training Program	Nelson-Denny Reading Test			Math Ach
	Voc	Read Comp	Total	Test
Anxiety Management	46.27	36.78	83.583	9.61
High Anxious	46.05	35.91	83.00	9.05
Low Anxious	46.50	37.67	84.17	10.17
Study Habits Development	48.46	36.92	85.38	10.06
High Anxious	46.25	39.50	85.75	11.00
Low Anxious	50.67	34.33	85.00	9.11
Training	0.337	0.002	0.087	0.492
hi/lo Anx	0.408	0.313	0.001	0.300
Anx X Training	0.263	1.260	0.024	5.245*
Pre-Post Test Performance	27.269**	3.849	4.334*	21.058**
Training X Test Performance	0.450	1.442	0.967	5.762*
Anx X Test Performance	0.003	0.776	1.589	0.873
Anx X Training X Test Performance	0.045	0.162	0.000	1.452

* P < .05
** P < .001

Mean test performance (pre + post-test) for Nelson-Denny Reading Test and Math Achievement Test and F values for treatment effects.

Math Achievement Test Performance. Parallel forms of a locally produced math achievement test were administered pre and post-training to the AM and SHD groups. A repeated measures ANOVA on these data revealed that post-test performance was significantly worse than pre-test performance ($F(1.32) = 21.06$, $p < .001$) regardless of treatment condition or subject anxiety level. There also were significant interactions between anxiety and training conditions and training and test performance. (see table 2)

Academic Performance. Mean accumulative GPA for the AMH, AML, SHDH, SHDL, and DC groups were approximately equivalent prior to the experiment (2.19, 2.10, 2.25, 2.12, and 2.23 respectively). Post-training performance changes were determined by subtracting pre-training accumulative GPA from post-training semester GPA, thereby yielding a GPA gain score. (Cumulative GPA was selected in preference to semester GPA for determining the pre-training GPA baseline since it provides a more stable estimate of the expected value of future GPA performance). Differences in GPA gain scores by training condition were analyzed by using the Mann-Whitney U-Test. Group comparisons indicated that the AMH group improved significantly more than the SHDH group (mean ranks 7.82 and 13.00 respectively) and the AML group (mean ranks 8.95 and 14.05 respectively). The SHDL group improved significantly more than the SHDH group (mean ranks 5.71 and 10.0 respectively), and the SHDL and AMD group both improved significantly more than the DC group. All other comparisons were non-significant. A summary of the results are in table 3.

TABLE 3

	AML	SHDH	SHDL	DC
AMH	U = 32*	U = 18**	U = 34	U = 20**
AML		U = 27	U = 32	U = 31
SHDH			U = 12**	U = 39
SHDL				U = 17*
AMH	14.05 8.95	13.00 7.82	10.21 9.05	14.50 7.82
AML		12.13 8.45	8.64 10.05	13.20 9.00
SHDH			5.71 10.00	9.60 9.38
SHDL				10.70 6.57

* P < .05, one tail
** P < .01, one tail

Mann-Whitney U-Test Comparisons between training programs (AM and SHD) by subject anxiety level and a demand control group and mean rank order for all comparisons (Data: GPA gain scores).

Discussion

The Anxiety Management program was effective in aiding both high and low anxious subjects in reducing anxiety level. All subjects demonstrated the ability to maintain frontal muscle group EMG below a 3.0mv/min level (see figures 2, 3, and 4). This is significant since a 3.0mv/min EMG level is frequently used as an indicator of relaxation (Budzynski, personal communication, October 1974). Furthermore, improvement in the ability to relax was also shown by the significant reduction in EMG level over training sessions. After only 5 training sessions, the mean EMG level for high anxious subjects was 29% of their training level, while low anxious subject's EMG levels were 43% of their initial level. This improvement is comparable to what is normally found for college students receiving a similar number of biofeedback training sessions (Reinking and Kahl, 1975).

Another indicator of the effectiveness of the Anxiety Management training program can be seen in the change in EMG levels from session 5 to session 6. Mean training session EMG levels increased between sessions 5 and 6, the end of block II, autogenic training, and the beginning of block III, stress management training (see figure 4). This increase indicates that the imaginary scenes used in stress management training were successful in inducing anxiety. With continued stress management training, the anxiety reaction to the stress images was reduced. It is interesting to note that the post-session baseline EMG values (figure 3)

for these same sessions were near tonic muscle tension levels, thus suggesting that the subjects learned to quickly abort the anxiety reaction and return to a minimal level of tension. This same rapid return to a minimal tension level was also observed after the last training session when EMG feedback was not provided. Apparently by this time the subjects had begun to rely on internal physiological cues to tell them when they were relaxed.

The IPAT 8 Parallel Form anxiety data provides a look at anxiety as perceived by the subject. The results indicate that subjective anxiety level was not lowered concomitantly with the reduction in physiological tension (i.e. lower EMGs) which accrued from Anxiety Management training. This noncorrespondence between psychological and physiological parameters of anxiety may be due to the nature of the IPAT 8 Parallel Form test. This test asks questions about annoyances, embarrassing situations, etc., which are likely to be answered based on a subject's prior experience. Since the subjects were in the process of learning how to cope with anxiety at the same time the IPAT 8 Parallel Form was administered, it seems unlikely that they would have had sufficient opportunity to use these skills in annoying or embarrassing situations. Therefore, it would seem reasonable that subjective anxiety as measured by the IPAT 8 Parallel Form would not change by the time it was administered. Changes in subjective anxiety would be expected once the subject has had time to integrate into his life style the newly acquired anxiety coping skills; however, data are not available to either confirm or deny this contention. It is suggested that for future research an anxiety scale which is sensi-

tive to current changes in anxiety be used in preference to the IPAT 8 Parallel.

The Nelson-Denny Reading test and the math achievement test were included in this experiment because it was felt that they would provide a more sensitive measure than GPA of the change in cognitive performance resulting from the experimental treatments. The results were not as anticipated because significant differences between anxiety and training program conditions were, in general, not found on these two measures. The only significant difference on the Nelson-Denny data was based on a change in vocabulary score from pre to post-test. The mean vocabulary score increased from 43.85 to 50.88 for all subjects, regardless of training program or anxiety condition. It is unlikely that this improvement in performance was due to any difference in difficulty level between forms C and D of the Nelson-Denny; however, it is possible that performance improved because the subjects were "test-wise" on the post-test, since it was administered only about 6 weeks after the pre-test. The math achievement test data are somewhat less clear. Post-test performance was worse than pre-test (mean 10.69 versus 8.99). Additionally the anxiety X training and anxiety X test performance interactions were significant. These interactions indicate that high anxious subjects evidenced the greatest decrement in performance on this test. Why this occurred is not known.

A review of the GPA data indicates that both the Anxiety Management and the Study Habits Development training programs were successful in positively effecting academic performance. High anxious students given Anxiety Management training demonstrated significantly greater academic improvement than either low anxious students who received the same training or high anxious students who received the Study Habits Development program. Additionally, low anxious students given the Study Habits Development program demonstrated significantly greater academic improvement than high anxious subjects given the same program. These findings indicate that only low anxious students benefited from the Study Habits Development program while only high anxious students benefited from the Anxiety Management program. Thus, if the training program was not matched to the student's anxiety level, the program was apparently rendered ineffective.

A Demand Control group was included in this experiment to control for any performance effects resulting from the demands for achievement a subject might place on himself simply because of the additional attention he had received from participating in this experiment. As expected, both the AMH and SHDL groups demonstrated significantly greater academic improvement than the demand control group, thereby indicating the benefits gained from both training programs were more than might be expected from merely devoting general attention to the subject's academic problems. It should be noted, however, that if subject anxiety level and training program were not properly matched, the benefits of both programs were no better than that derived from a simple increase in student attention.

Reviewing the GPA data as a whole, it appears to provide a strong argument for the position that if a student suffers from test anxiety, academic improvement will not result until that problem can be overcome. This suggests the importance of identifying why a student is not performing well academically before providing a prescription for the problem. To simply assume that the problem is lack of motivation, or poor study habits and then to propose a standard program is inefficient and a waste of time for the student. Clearly, effective diagnostic techniques for ascertaining the cause of academic deficiency must be developed along with the development of training programs tailored to meet specific academic problems.

The fact that the Nelson-Denny and math achievement data did not correspond with the GPA data somewhat weakens the above argument. Although it is not clear why predicted differences were not found on these tests, a few explanations seem possible. First, even though testing time for the Nelson-Denny was shortened in an effort to increase subject anxiety, this technique may not have had the desired effect. The subjects were aware of the test time and the length of the test, but they were not aware of the fact that testing time was abbreviated from normal. Had this information also been provided, perhaps anxiety would have increased. Also, the second administration (post-test) of the Nelson-Denny probably was more anxiety producing than the first. This is probably true for two reasons. First, the subjects were aware that their performance on the second form of the Nelson-Denny would be compared with their initial effort. Second, many subjects reported being more anxious

the second time, which was probably due to their desire to "help" the experimenter, since he had spent a great deal of time with them. The resultant increase in anxiety probably helped the low anxious subjects and interfered with the high anxious subjects' performance due to their different starting points on the anxiety/arousal curve (see figure 1).

Another factor which may enter into the lack of significant results of the Nelson-Denny and math achievement tests is related to the timing of the second administration of the test. Goldfried and Trier (1974) suggest that it takes time to integrate new coping strategies into a person's life style, and that changes in behavior will not be apparent until this integration takes place. Perhaps this is why there were no differences in performance on the Nelson-Denny or Math Achievement tests due to the training programs, as the post-test was administered immediately after training and thus the subjects did not have time to integrate the new coping strategies into their everyday life.

The above explanation can be used in reverse to account for the significant results obtained with the GPA data. The AM subjects probably had time to incorporate their newly learned coping skills into their daily life prior to completing all graded course requirements. Consequently, these skills were most likely used during some examinations. Thus, the benefits of AM training would be reflected in the GPA data.

EXPERIMENT II

Introduction

The results of Experiment I indicated that the Anxiety Management training program was beneficial to cadets suffering from test anxiety. The number of hours involved in this training, however, were such that it would be impossible to provide the Anxiety Management program to a large number of students in its present form. One of the purposes of this experiment was to see whether or not similar gains in anxiety reduction and performance improvement could be achieved from an essentially self-administered Anxiety Management program. Additionally, the authors were also interested in determining whether or not a combined Anxiety Management/Study Habits Development program would yield even better performance gains than either one alone, therefore, this training condition was also investigated in this experiment.

Method

Subjects. The subjects were 28 male cadets who were in their second year at the United States Air Force Academy. All subjects were volunteers selected on the basis of academic deficiency. The current mid-semester GPA was below 2.0 for each cadet; their mean accumulative GPA was 2.07. The IPAT Self Analysis Anxiety Scale was used to dichotomize the subjects into high and low anxiety groups. The median low anxious

subject score was at the 18th percentile for college males (range 35-04%ile) while the median high anxious score was at the 76th percentile (range 96-50% ile).

Apparatus The apparatus was the same as that used in Experiment I, with two exceptions. First, voice contact via microphone was eliminated. Second, all nine Anxiety Management lessons were recorded on cassette tape. A Panasonic tape recorder (model RQ 209S) was configured to allow tape playback of the Anxiety Management lessons directly into the stereo headset simultaneously with the EMG feedback signal.

Procedure. A double blind technique was used to randomly and equally divide all high and low anxious subjects into an Anxiety Management (AM) training group and a combined Anxiety Management X Study Habits Development (AM/SHD) group.

For those subjects receiving Study Habits Development training, the procedures were essentially the same as those used in Experiment I. The procedures for Anxiety Management training were somewhat modified. First, the IPAT 8, Parallel Form Anxiety Test was not given. Second, after a subject was instructed on how to attach the electrodes, he became responsible for attaching his own electrodes. Third, the subjects were instructed to schedule themselves for using the cassette tape Anxiety Management lessons. They were asked to try and complete one lesson every other day, excluding weekends, and to practice at home without the tape on the off days. The cassette programs followed as closely as possible

the scripts used in Experiment I. One major change from Experiment I, however, was that EMG feedback was provided beginning with the first session, instead of beginning with Session 3. EMG level was recorded for five minutes before and after sessions 1,5 and 9. This was the only time EMG feedback was not provided.

Due to a variety of reasons, the experiment was started much later than intended. As a result the experiment did not begin until near the end of the academic semester when the cadet subjects were beseiged by computer science projects, reports, and numerous exams. Consequently, a large number of subjects (13) failed to complete the experiment due to these outside pressures, which, ironically, were the exact pressures the experiment was designed to help the cadets cope with.

Results

Anxiety Management Training. Since AM training was the same for all subjects, regardless of whether or not they received SHD training, the EMG data were collapsed across training conditions. Figure 5 shows the change in EMG level for AM sessions 1, 5, and 9 by anxiety condition. By the end of session 5, the end of block II training, low anxious subjects had reduced EMG level to 2.65 mv/min, a 53% reduction while high anxious subjects' EMG level was 1.40, a 73% reduction from initial baseline. At the end of training (session 9) EMG levels for high and low anxious subjects were 0.93mv/min and 1.27mv/min, or 83% and 60% lower than pretraining EMG levels. A repeated measure ANOVA on the EMG data was significant

($F(2, 26) = 11.16$, $p < .001$) for only the EMG main effect.

Tape vs Live Anxiety Management Training. EMG data for subjects in Experiment I and Experiment II were compared to determine differences resulting from a live versus tape anxiety management program. Independent 2X2 ANOVAS comparing subject anxiety level and Anxiety Management program administration procedure were performed using pre-training baseline, and post-session 5 and 9 EMG levels as data. The results of this analysis are in Table 4. None of the comparisons were significant.

Academic Performance. GPA gain scores were calculated in the same manner as in Experiment I. These scores were then compared for subjects in the four experimental conditions: Anxiety Management, high (AMH) and low (AML) anxious, and Anxiety Management/Study Habits Development, high (AM/SHDH) and low (AM/SHDL) anxious. Mean accumulative GPA for the AMH, AML, AM/SHDH, and AM/SHDL were similar prior to the experiment (2.14, 2.15, 2.09, and 2.01 respectively). The Mann-Whitney U-Test was used for all comparisons. All treatment conditions had an equal number of subjects (N=4) with the exception of the AM/SHDL group which had only 3 subjects. U-values and mean ranks for all comparisons are summarized in Table 5. None of the comparisons were significant.

Discussion. Presenting the Anxiety Management program in cassette tape form proved to be an adequate method for presenting this kind of training. By the end of training all subjects had reduced their EMG level to well below the 3.0 mv/min criterion. Furthermore, their performance was

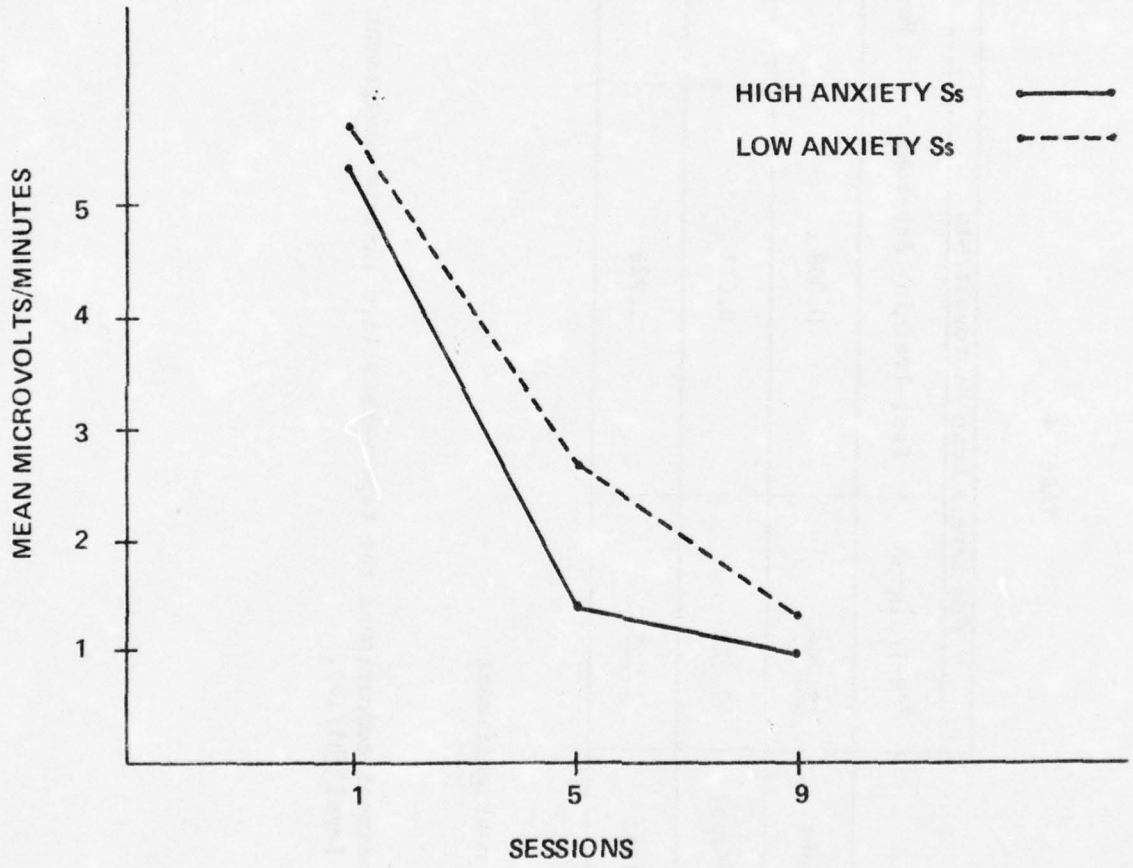

FIGURE 5. INITIAL BASELINE (SESSION 1) AND POST-ANXIETY MANAGEMENT TRAINING SESSION (SESSIONS 5 AND 9) EMG (FRONTAL MUSCLE TENSION) LEVELS FOR HIGH AND LOW ANXIOUS SUBJECTS.

TABLE 4

	EMG Levels Mean Microvolt/Min		
	Pre-Training	Post-Training Sessions	Post-Training Session 9
Anxiety (High/Low)	0.799	0.008	1.237
Training (Live/Tape)	0.088	0.011	0.003
Anxiety X Training	1.223	1.928	0.035

All comparisons nonsignificant

F values for treatment comparisons for tape versus live anxiety management training by subject anxiety level (hi/lo).

TABLE 5

	AML	AM/SHDH	AM/SHDL
AMH	U = 12	U = 12	U = 9
AML		U = 7	U = 6
AM/SHDH			U = 6
AMH	3.5 5.5	3.5 5.5	3.00 4.75
AML		4.75 4.25	4.00 4.00
AM/SHDH			4.33 3.75

All US - non significant

Mann-Whitney U-Test comparisons between training programs (AM and AM/SHD) by subject anxiety level (Data: GPA gain scores) and mean rank order for all comparisons.

nearly identical to the subjects receiving a live Anxiety Management program in Experiment I. Also, as in Experiment I, the high anxious subjects in this experiment evidenced around a 70% reduction in EMG while low anxious subjects reduced EMG by about 55%. Coupled with the fact that there were no significant differences between subjects receiving either the tape or live Anxiety Management program, this clearly indicates the effectiveness of the tape program.

Contrary to Experiment I, significant differences between training groups as a function of the subject's anxiety level were not found in this experiment. Although this tends to make suspect the results of Experiment I, there is reason to consider the results of Experiment I to be more valid than those from Experiment II. Experiment II suffers from two problems. First, the number of subjects in each condition was considerably less than the number in Experiment I. Additionally, since the experiment was conducted the month prior to final exams, many subjects appeared to be unwilling to change their mode of operation in studying and preparing for exams. Therefore, the effect of the Study Habits Development program probably was minimized. There is also reason to believe that the potential benefits of reduced test anxiety resulting from the Anxiety Management would not be reflected in GPA. As mentioned previously, Goldfried and Trier suggest the importance of integrating the results of relaxation training into one's life style. Clearly the subjects in this experiment did not have time to accomplish this in time to effect their current semester GPA. Furthermore, since the only remaining input to the GPA after completing the training programs on the experiment were final

exams, it is unlikely that the subjects could change course grades enough to significantly effect their overall GPA, even if the training programs were effective and sufficient time for integration were available. Taken together, all of these factors suggest that the performance data from Experiment II may be unreliable and should therefore be viewed with caution.

EXPERIMENT III

Introduction

This experiment constituted a 6 months post-experiment follow-up of Experiment I. The purpose of the experiment was to determine whether or not the EMG and performance changes recorded in Experiment I were sustained over time.

Method

A 5 minute resting level EMG measurement was taken for all Experiment I Anxiety Management group subjects approximately 6 months after the completion of Experiment I. The subjects did not receive any additional EMG feedback training during this 6 month interval, nor was there any formal contract between them and the experimenters.

Result

Anxiety Management Training. Resting EMG readings taken 6 months after the completion of Experiment I were compared with post-session resting

EMG levels for sessions 5 and 9 of Experiment I. Mean EMG levels for high and low anxious subjects were compared separately.

A 2 X 2 repeated measures ANOVA was not significant when 6 month post-training EMG was compared with either post-session 5 or post-session 9 EMG. These data are summarized in table 6 and figure 6.

Academic Performance. GPA gain scores were again calculated in the same manner as in Experiment I. The Mann-Whitney U-Test then was used to make performance comparisons between high and low anxious subjects in the AM, SHD, and DC groups. These comparisons are summarized in table 7. Only 3 of the 10 comparisons were significant. The SHDL group improved GPA significantly more than the AML group, and the SHDH group out performed both the SHDL and the DC group.

Discussion

The EMG data revealed that the subjects retained the ability to voluntarily induce relaxation up to 6 months after post training. This ability was maintained even though no additional training or feedback refresher experience was provided. Thus it seems safe to say that based on the initial level of learning from Experiment I, the ability to reduce EMG level had become relatively permanent for the subjects involved.

Perhaps learning to control EMG is similar to learning a psychomotor skill, such as riding a bicycle. If a person rides a bicycle two or

TABLE 6

	Session 5 / 6 month	Session 9 / 6 month
ANX	0.081	0.294
EMG	0.225	1.790
EMG X ANX	0.657	0.504

All Fs non significant

F values comparing 6 month post-training frontal EMG levels for anxiety management subjects with post-session 5 and 9 EMG levels.

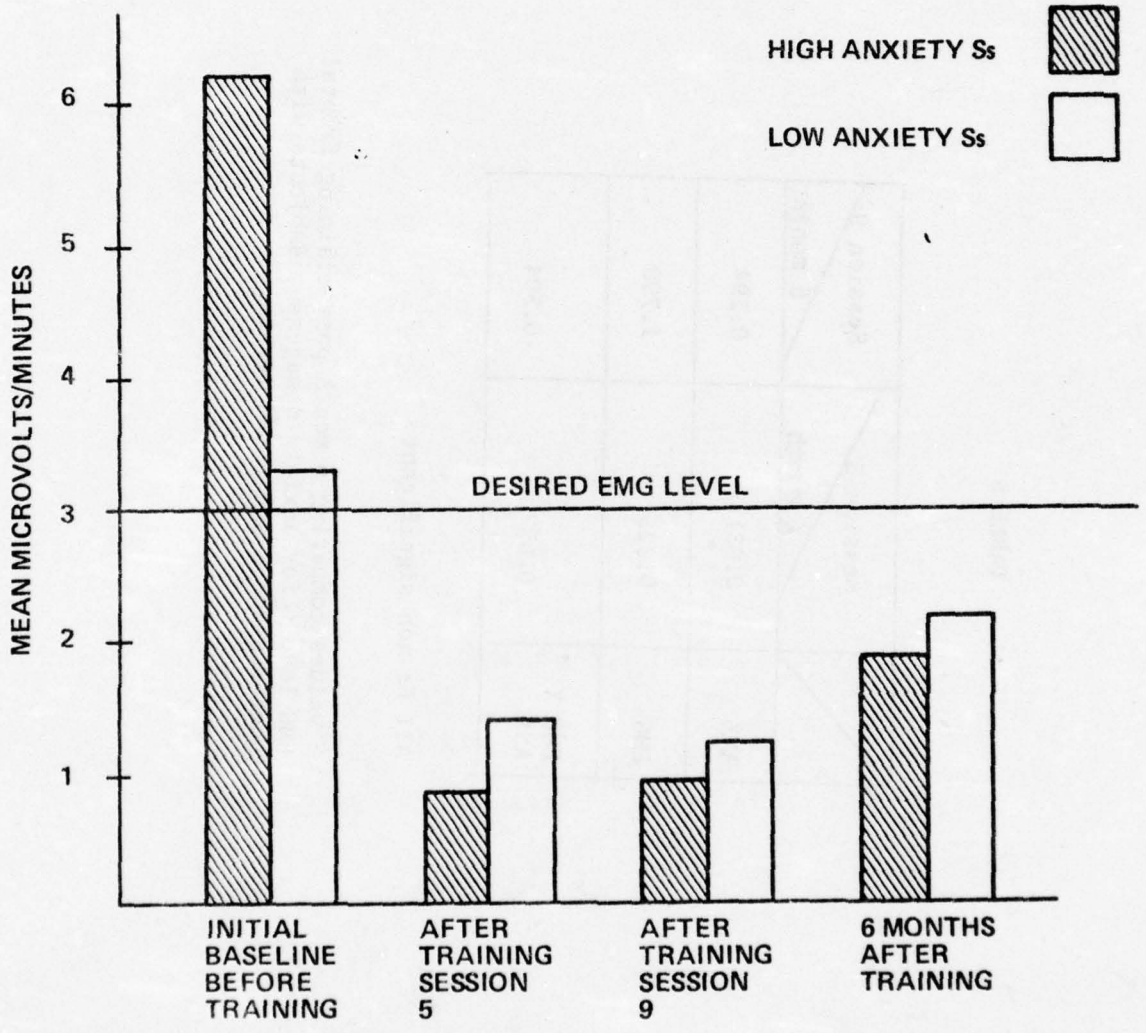

FIGURE 6. FRONTAL EMG LEVEL (PRETRAINING BASELINE, POST-SESSIONS 5 AND 9, AND 6 MONTHS POST-TRAINING) FOR SUBJECTS RECEIVING ANXIETY MANAGEMENT TRAINING.

TABLE 7

	AML	SHDH	SHDL	DC
AMH	U = 31	U = 20	U = 30	U = 48
AML		U = 23	U = 16**	U = 45
SHDH			U = 12*	U = 23*
SHDL				U = 30
AMH	11.63 10.30	6.63 11.80	8.29 9.50	11.64 10.30
AML		7.63 11.73	6.86 10.27	11.09 11.91
SHDH			10.29 6.00	11.91 7.38
SHDL				10.27 8.29

* P < .05, one tail ** P < .01, one tail

Mann-Whitney U-Test comparisons between training programs (AM and SHD) and a demand control group and mean rank order for all comparisons (Data: GPA gain scores).

three times but then does not attempt to ride for a long time, say 4 or 5 years, his performance will probably regress to initial levels. However, once the skills involved in bicycle riding are well learned, one can survive a lengthy break in practice without suffering a significant decrement in performance. This same situation may be true for EMG control. If one does not receive enough practice initially, the ability to control EMG may be fleeting; but once practice exceeds some critical point, the skill becomes essentially permanent.

Only one significant comparison was in the predicted direction for the performance data (i.e. GPA gain scores). If the theory that only high anxious subjects will benefit from Anxiety Management training is correct, then it would not be surprising to find low anxious subjects in the SHD group out performing low anxious subjects in the AM group, which is exactly what was found. The superior performance of the SHD high anxious subjects relative to the SHD low anxious and DC subjects, however, was contrary to expectations and the results of Experiment I.

GENERAL DISCUSSION

The series of experiments in this report represent the author's preliminary efforts to devise a program to help the test anxious student. Generally the high anxious subjects reported feeling less anxious after Anxiety Management training. Additionally, the results from Experiment I indicate that the Anxiety Management program had a positive effect on academic performance for high anxious subjects while the Study Habits Development program was beneficial to the low anxious subjects. The Experiment III results indicate, however, that the relative value of the AM and SHD programs was only realized in the short term. The differential gains in GPA for high and low anxious subjects receiving these two programs was not sustained over a 6 month period. It is important to note 7 of the 10 high anxious AM group subjects continued to show GPA improvement 6 months after training; however, this improvement was not any greater than that achieved by subjects in the other training groups. This suggests that in its present form, the AM program will only provide a short term fix for high anxious subjects. Perhaps with additional AM practice this short term gain can be turned into a long term cure.

Due to the timing of Experiment II, the academic performance results would appear to be of limited value. Probably the most important information gained from this experiment is in terms of the efficacy of presenting the Anxiety Management program on cassette tapes. The Experiment II results indicated that at least under favorable (non-stress) conditions,

both high and low anxious subjects could learn to control EMG essentially as well as high and low anxious subjects receiving a live AM program. The question remains, however, whether or not this ability will have an effect on performance.

The results from Experiment III tend to confuse rather than to clarify interpretation of the results from Experiment I. On the one hand, it appears that the ability to control EMG is still intact. But on the other, this ability no longer appears related to performance improvement.

Perhaps there are a number of factors at play here which create this situation. It is possible, for instance, that the AM subjects do not have the ability to control EMG under all conditions. In Experiment III, EMG control was tested in a non-stress environment. The important question is, however, whether or not the demonstrated EMG control would hold up when the subject is under stress in taking an exam. If EMG control were to break down in the presence of stress, then this would suggest that the initial training of Experiment I was not adequate to provide long term control over EMG under all conditions.

Another plausible reason for the disparity in performance results between Experiment I and III may be due to differential practice for subjects in the AM and SHD groups. It was comparatively easy for SHD subjects to practice the new study techniques since the SHD program was provided in textual form. This text could be referenced at the subject's convenience. The AM subjects did not have a similar situation. They did not have the

same impetus to practice, and without practice, learning acquired from the AM training may not have been sufficient to become permanent. Further, even though AM subjects could continue to practice their relaxation technique, the only way the success of this training could be evaluated was by relying on internal cues. If transfer of control from the artificial biofeedback signal provided in the AM program to internal physiological cues had not been accomplished, the subject's continued practice would not be beneficial, and potentially detrimental. Thus, lack of practice, or ineffective practice, might account for the fact that AM subjects did not continue to improve GPA at a faster rate than SHD subjects.

Overall, more questions were raised than answered. Probably the most significant of these questions deals with the issue of identifying the students who are most likely to benefit from Anxiety Management training. The answer to this question revolves around the ability to identify cognitive/psychological anxiety and the students scholastic ability level.

It is standard procedure to use a psychometric test to measure anxiety. Unfortunately, there is some danger in using this procedure. First, it is not certain that all psychometric measurements of anxiety are actually measuring psychological anxiety. Second, the test score used to separate subjects into high and low anxiety groups is made in a somewhat arbitrary fashion. Generally, a researcher has a limited subject pool from which to draw his subjects. Consequently, a given score value on an anxiety test may be classified as being either high or low anxious for a particular

experiment as a function of subject availability. Needless to say, to some extent the experimental results hinge on this classification.

It is also possible to use various physiological parameters to measure psychological anxiety. The ascending reticular activity system (ARAS) of the central nervous system (CNS) appears to be activated when a person experiences anxiety. It has been demonstrated that skeletal muscle action potentials reflected in an EMG record are correlated with sympathetic CNS arousal and ARAS activation. (Budzynski and Stoyva, 1972; Malmo, 1966). Therefore, EMG can be used as a measure of anxiety. However, it is interesting to note that some researchers have failed to find correspondence between EMG level and psychometric measures of arousal (Breeden, Bean, Scandrett, and Kondo, 1975). Obviously, EMG measurements and psychometric measurements of anxiety may not be measuring the same thing. The question then, is what measure of psychological anxiety is most effective in identifying those individuals who will most profit from an anxiety management program?

The importance of the initial determination of anxiety became painfully clear in Experiment II. When the relationship between initial resting level EMG's were compared with IPAT scores little similarity was found between the two ($r = +.04$). The subjects were classified into high and low anxious groups according to IPAT score and not initial EMG level. It will be remembered that performance differences were not found between conditions and anxiety levels. It is interesting to speculate what the results would be had EMG level been used to classify

the subjects.

The problem of anxiety classification was not apparent in Experiment I, for there was good correspondence between IPAT scores and initial EMG levels. Nevertheless, the issue of how to determine anxiety is still vital to the success of an anxiety management program. This issue is currently under investigation by one of the authors.

The relationship between subject ability level and anxiety level is equally as important in determining who will most benefit from Anxiety Management training. Spielberger (1966), in reporting on a series of experiments, indicated that high ability (high IQ), high anxious students out-perform all other students. High anxious, low ability (low IQ) college students demonstrated a lower level of achievement than all other students. Speilberger's findings suggest that high ability students can overcome the negative effects of heightened anxiety, while low ability students can not. This situation can be explained by referring to the anxiety/arousal performance relationship. Since normal college work would be easy for high ability students, it can be seen from figure 1 that optimal performance will result with high anxiety/arousal. On the other hand, normal college work would be difficult for low ability students; consequently, high anxiety/arousal would be detrimental to their performance (figure 1). Assuming that a student has the minimum ability to succeed in a given program, Speilberger's results suggest that low to moderate ability, high anxious students are most likely to benefit from an Anxiety Management program.

In conclusion, the authors believe that this research suggests the feasibility of designing an effective Anxiety Management program which can impact on performance. Also, biofeedback appears to be a tool which can be used effectively in such a program. However, more work needs to be done. The questions raised and the explanations postulated to account for the findings of this research provided many areas where further research is badly needed. We believe the Air Force should continue to support research in this area. The potential payoffs are numerous. It should be clear that an effective anxiety management program could help reduce attrition from the Air Force Academy, Undergraduate Pilot Training, Technical Training, and increase personnel effectiveness under various conditions, particularly those which are highly ladened with stressors.

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APPENDIX A

ANXIETY MANAGEMENT PROGRAM

SESSION 1: Tense-Relax and Baseline EMG Data

A. EMG Baseline Data. This is the first time the cadet will be introduced to the EMG equipment. Show him how the equipment works and relieve any anxiety about electric shock, etc. Connect the electrodes to the frontalis the way you have been taught. Be sure the record interval is set on the 64 sec. record setting and then record EMG for 3, 64 sec. periods, indicating EMG level for each recording period. Tell the cadet to get into a comfortable position in the chair to keep his eyes open, and to take three (3) deep breaths and to relax as deeply as he can. Forewarn the cadet you are going to let him relax for about 4 minutes without interruption.

B. Administer Anxiety Scale (IPAT parallel 8, form B)

C. Tense/Relax. With the subjects seated, tell them that you are going to start training them how to notice tension and how to eliminate it. Follow the below sequence:

Say to Subject	Notice
1. Assume a comfortable position.	Is S rigid? If so, repeat instruction.
2. Take a deep breath and hold it -- slowly exhale and "feel" your self sinking deeper into the chair.	If S does not take a noticeable breath, repeat instruction. Record data (EMG) 64 sec. record periods for entire session.
3. Keep your eyes open but defocused so things look fuzzy --- Don't focus on my voice ---- let it be in the background.	Combine recording EMG for the whole session.

Say to Subject	Notice
4. Try not to think about things you have to do today ---- just let your mind wander.	Make sure S's arms are on the arms of the chair.
5. OK, now I want you to make a fist with your right hand ---- Notice the tension in the forearm -- really feel it -- focus on it ---- now drop your hand suddenly - - - feel the tension rush out your finger tips -- -	Note - don't have S maintain tension too long (i.e. more than 10-12 sec.)
feel how relaxed your arm is- - focus on it.	45 - 60 sec.
6. Repeat procedure in 5 above - - Notice the difference in feeling between tension and relaxation.	45 - 60 sec.
7. Same procedure as 5 above but with left arm. (Say) "Let the tension go - - - let it flow out".	45 - 60 sec.
8. Now shrug your shoulders - - - raise them to the sky - - mentally make a picture of what the tension feels like ---	10 - 12 sec.
Relax - - - Note difference.	45 - 60 sec.
9. Repeat 8 twice.	

10. Have S breathe normally - - feel comfortable- - - take a deep breath - - - exhale and relax again.	
11. Imagine yourself floating on a raft in the ocean. Feel yourself swaying with the waves. It feels good, peaceful, relaxing. Float with the waves. Let your concerns, fears and anxieties go - - - Be free and relaxed.	
12. Now, bite down with your teeth- feel the tension in the jaw & facial muscles - - - relax - - feel good, just floating on the water.	8 - 12 sec. 45 - 60 sec.
13. Repeat 12. It feels good to be relaxed.	
14. OK, now wrinkle your forehead - - - really frown - - - good- - relax - - - Notice difference.	8 - 12 sec. 45 - 60 sec.
15. Repeat 14.	
16. Tense your abdominal muscles, really tighten your stomach - - Relax - - feel good - - - Notice how pleasant it is to relax.	10 - 15 sec. 45 - 60 sec.

Say to Subject	Notice
17. Repeat 16. Notice difference between tension and relaxation.	
18. Stretch your arms - - - feel awake- - - feeling good, ready to meet the world.	Tell S the session is over and that you will be in to unhook him from the apparatus. Remember, talk to him! Don't be cold and indifferent when disconnecting him from the B-1

END OF SESSION

SESSION 2: Differential Relaxation

Administer IPAT Anxiety Scale (Form C)

Say to Subject	Notice
1. Subject seated in comfortable chair. Tell him that today you are going to have him tense some muscle groups while relaxing others at the same time.	About 2 min.
2."Take a deep breath - - hold it- - slowly exhale - - - feel yourself floating down in the chair"	
3. "Keep eyes open - - but let the world appear fuzzy - - defocus your eyes - - feel relaxed - - let all the energy leave your body".	
4. "Look for tension in your shoulders- - (pause)- - your neck(pause)- - and your jaw (pause). If you find any tension then just let it go".	About 1 min.
5. "Be sure you are not biting down with your teeth. Keep your jaw loose, with a small separation between your upper and lower teeth".	

Say to Subject	Notice
6. OK, do an isometric with your right arm- - - hold it out straight with a closed fist- - keep the rest of your body relaxed". "Keep your breathing normal and regular".	Key tension for 15-20 sec.
7." Now suddenly relax- - -feel tension rush out- - feel good- - warm- - relaxed".	About 45 sec.
8."OK, now raise your left arm, clench your fist- - - hold it- - feel tension- - really focus on it- - - let the rest of your body be relaxed- - - ." "Note the difference- - good- - "	About 15-20 sec.
9. "Now relax your entire body- - release the energy- - -feel calm and peaceful."	About 45 sec.
11. "Do an isometric with both your right arm and leg- - breath normally- - - relax the rest of your body- - - focus on the difference in feeling between tension and relaxation".	20-25 sec.
12. "Relax- - - let yourself go loose."	30 sec.

Say to Subject	Notice
13. Repeat #11, but "this time focus on the relaxed part of your body- - let it be limp as possible- - allow the energy to leave".	20 - 25 sec.
14. "Relax- - - feel calm- - at ease".	30 sec.
15. "Now do an isometric with your left arm and leg- - keep the rest of your body relaxed- - you can do it- - - notice the difference".	20 - 25 sec.
16. "Quickly and suddenly relax- - notice how good it feels- - - release all of the energy- - - good".	30 sec.
17. "Press down on the floor with both feet as hard as you can- - feel tension in your legs- - - keep the rest of your body relaxed- - Note how your arms, shoulders, and neck feel- - - let them be relaxed"	20 - 25 sec.
18. "Now relax- - enjoy the opportunity to relax- - feel warm and good".	30 sec.

Say to Subject	Notice
19. Repeat #17- - - "focus on your arms, shoulder, and neck relaxed- -notice how they feel- "remember that feeling- - good"	20- 25 sec.
20. "Relax"	30 sec.
21. "Tense both of your arms- - - hold it - - relax the rest of your body- - - particularly your abdominal muscles (stomach)." "notice difference"	20- 25
22. "Relax- - just really get loose and enjoy yourself".	30 sec.
23. "Tense your right arm again- - keep all other muscles loose- - (pause) - - notice the difference- - just let everything hang loose except your right arm- - good- - "	20 - 25 sec.
24. "Relax- - float back into the chair- - - feel yourself sinking lower-- - and lower- - - good- - - just enjoy the moment- - - "	1 min.

Say to Subject	Notice
25. "Now imagine tension in your right arm but don't do an isometric- - - stay relaxed- - "	1 min.
"can you almost <u>feel</u> the tension in the right arm?- - really try to feel it- - good"	1 min.
- - - Now relax	Take end baseline, about 2 min.
26. It's time to end so "stretch your arms and legs- - - stand up- - and feel alert and ready to work."	
	Talk to subjects - How did it go?

END OF SESSION

SESSION 3 - EMG Feedback Training

Before the cadet subject arrives check the noise reading with the dummy load on the electrode strip. Adjust the noise cancellation switch until the reading is between .15 and .50 (64 sec. recording service) and record the reading on the data collection sheet. Refer to the general instruction sheet and perform necessary functions, as required. (IPAT Anxiety Scale, Form D)

Comments to Subject	Actions to Take
1. "Take deep breath - hold - slowly exhale - - - sink into chair - - float down - - - feel all the energy rush out of the body." "Feel cares disappear." "Keep eyes open but defocused - world seems fuzzy - - - don't focus on anything in particular - especially forget about events of the day. Don't focus on my voice, but keep it in the background with the clicks."	Make baseline measurements - - 2-3 minutes (64 sec. record period).
2. "Right arm tense. Feel. Relax. Note difference."	During 20 sec. time out period.
3. Have S say "My arm is heavy. My arm is warm and heavy. My arm is letting go - - - (repeat)"	Start Recording EMG - about 2 min.
4. "Left arm tense. Feel. Relax. Note difference."	During 20 sec. time out.

Comments to Subject	Actions to Take
5. Same as #3.	Record EMG - about 2 min. Reinforce good performance - - e.g.
6. Lift shoulders to ears. Tense. Relax.	"Hear the clicks slowing down. This means that you are relaxing- - - good - - - notice how you feel" etc.
7. Have S say " My shoulders and arms feel warm and heavy. I feel limp like a rag doll - - and, my head feels cool and calm - - - - . (repeat)	Record EMG - about 2 min.
8. Have S say " My neck feels loose and relaxed. My body is relaxed - - - My head feels cool and calm ---- - .	Record EMG - about 2 min.
9. Tense abdominal muscles. Relax.	During 20 sec. non-record interval.
10. Have S say "I feel quiet. My whole body feels quiet, comfortable, and relaxed --- (Repeat).	Record EMG - about 2 min.
11. Say nothing	End baseline reading. (about 2 min).
12. "Stretch arms and legs"	
13. Say "I feel awake and alive. I feel good all over".	Tell Ss the session is over and that you are coming in to disconnect him from the equipment. Remember, talk to the S, debrief him, see how things were going, at least subjectively. Take notes on Data Sheet. Refer to general Instructions.

END OF SESSION

SESSION 4: Continue Warm and Heavy

(IPAT Anxiety Scale, Form E)

Comments to Subjects	Actions to Take
1. Use standard beginning (deep breath, etc.)	Baseline Record 2 min.
2. Keep my voice in background- - - just let it exist- - - don't focus on it.	
3. Let the energy flow out- - - This is your time, use as best you can- - - leave your worries and concerns behind- - - just relax	
4. With eyes open and defocused, think about your <u>right</u> arm and say "I feel warmth coming down my arm to my fingers- - - my arm is getting warmer (repeat)"	During 20 sec non record period Record 2 min.
5. My right arm is feeling very warm and good- - - my head feels cool and calm (Repeat and have <u>S</u> say to himself).	During 20 sec non record period Record 2 min - always verbally reinforce good relaxation (e.g. notice the clicks getting slower, good)
6. Let yourself go- - - be a rag doll, feeling limp and good. Say "*I feel quiet and relaxed-- my* head is cool and clear (repeat)"	During 20 sec non-record period Record for 2 min.

Comments to Subjects	Actions to Take
	Reinforce good relaxation.
7. Tense both forearms- - -notice tension- - suddenly relax- - - Note difference- - - feel energy rush out, feel the fingers tingle - - - and say - - "My arms are warm and heavy. My arms are like weights- - as heavy as lead- - - I feel good and relaxed (repeat)"	During 20 sec non-record period. Record 2 min.
8. Tense shoulders and arms - - Relax- - - Say "My arms and shoulders feel warm and heavy. They are getting warmer and warmer. My head feels cool and calm (Repeat)"	During 20 sec. non-record period. Record 2 min.
9. Stretch and feel awake and alive.	Unhook S.

END OF SESSION

Refer to general instructions.

SESSION 5: Deep Relaxation

This is a critical session in the biofeedback training program. Some cadets will meet our goal of a 3.0 microvolt EMG level (64 sec.) or better and therefore will be ready for Stress Management Training. For those who do not meet the desired level, a more personalized training program will be instituted. Be prepared to handle this situation by following the appropriate branch in the scheduled program. Familiarize yourself with all contingencies and what you are to do under each situation. (Administer IPAT, Form E).

Comments to Students	Action to Take
1. Same as item #1, Session 4	Record baseline EMG - 2 min. If level approach 3.0 M volts, continue recording, otherwise go to #2.
2. Imagine yourself walking in a forest- - -it's a beautiful day- - birds are singing- - -the sky is blue- - -everything is quiet- - peaceful- - - you feel refreshed, and relaxed.	20 sec. time out Record EMG 64 sec.

Comments to Students	Action to Take
3. You are feeling more relaxed now- - loose- - free- - with no cares or worries- - - enjoying your walk, smelling the flowers, feeling warm- - and at one with yourself. You are feeling more and more relaxed.	20 sec. time out
	Record EMG 64 sec.
4. Let yourself simply exist- - - feeling almost ethereal and very relaxed- - - floating to a deeper and deeper relaxed state.	20 sec. time out.
	Record EMG - about 2 min.
	If EMG reading is between 3.0-3.5 M volts/ 64 secs., continue with program. Otherwise, branch to Program 2.
5. You are feeling very relaxed now, almost as if you are in another world- - - enjoy the feeling- - you are at one with yourself and the rest of the world- - -	during 20 sec. time out
	Record EMG - about 2 min.

Comments to Students	Action to Take
6. You are doing fine- - notice how slowly the clicks are sounding- -	Record EMG- about 3 min. - Baseline -
7. All good things must come to an end, and now is the time to come back to the real world- - slowly stretch your arms - - now your legs- - feel mentally alert, alive, ready to meet the world.	Refer to general instructions.

END OF SESSION

SESSION 6: Stress Management

Do not begin this session unless the subject's session 6 EMG level was 3.0 microvolts or lower. If S's EMG was between 3.0-3.5, then go back and repeat session 6. Be sure you note this on the data collection sheet. If S's session 6 EMG level was above 3.5 microwaves, branch to the personalized program. Continue with that program until a 3.0 level is recorded, or for four sessions, which ever occurs first. If the S is ready for stress management training, continue as usual, however, you must also do two additional things. First, give the S the switch which controls the light mounted on the outside of the acoustic chamber. Tell him that you will be asking him to press this switch throughout the session at times when he thinks he is most relaxed. Indicate that switch closer turns on a light to let you know when he is relaxed. Second, tell the S that today you are going to ask him to imagine different testing scenes, and in order to make them as real as possible you want to know three courses that he has which have GR's scheduled in the near future. Find out how he has been doing in the courses and write this down, along with their names. Now you are ready to begin.

Say to Subject	Notice
1. S in comfortable position- - deep breath- - -hold- - - slowly exhale- - - relax- - - - - - float down into the chair etc.	record baseline
2. Continue to relax- - feel good enjoy the moment- - -don't worry about what you have to do today - - let your mind wander	20 sec. time out Provide verbal feedback, as appropriate
3. Now have S imagine he is sitting in a classroom, listening to a lecture- - -Ask S to signal (depress button) when he has the image- - - Say, it has been a good class, the lecture is interesting- - pause- - -but now the instructor tells you that there will be a quiz next class.	Record continuously Insert the name of a course S is taking

Say to Subject	Notice
4. Think about taking the quiz- - pause- - (if S feels anxious, have him press the button, then tell him to turn off the image; otherwise continue) You are now taking the quiz and you find a question that you can't answer; your mind starts to whirl, but you notice it, take a deep breath, and say to yourself- - " My head feels cool and calm. I am relaxed and my mind is clear" (Have S signal when he feels most relaxed)	record continuously have S respond any time he is feeling anxious, then have him switch off the scene and relax.
5. You feel relaxed, and you start to see the solution to the problem- - - you write it down- and feel good- - - relieved	Reinforce good relaxation or otherwise validate Ss subjective feeling
6. Switch off the image and just relax- - good- - just feel pleasant, warm, and comfortable	64 sec.

Say to Subject	Notice
9. Now, picture yourself working in a problem set in _____. You are working at your desk again (have S report when he gets the image) Things aren't going too well- - you had a bad day in class and you lost in intermurals- - you can feel the frustration starting to build up- - -feel the frustration coming- - -recognize it, now relax, let the energy go and say "I feel relaxed, my arms are feeling warm and heavy (pause) My arms are warm, and heavy	don't let frustration build too long reinforce good relaxation
10. Now, just relax completely. Let your mind wander through your body looking for tension, starting with your toes and working toward your head. Let the energy out, and feel the relaxation come in.	end baseline record about 2 min.
11. OK, now stretch your arms and legs- - feel awake and alive- - ready for action	Refer to general instructions

END OF SESSION

SESSION 7: Stress Management

This is a continuation of Session 7. This time provide the subject with biofeedback. Then, the subject should be able to recognize his tension level more readily and, at the same time, the feedback should aid him in developing a relaxed response in the presence of an imaginary stressor.

Say to Subject	Notice
1. S in comfortable position-- deep breath--- hold--- slowly exhale---feel relaxation coming in---feel yourself drifting into the chair-- becoming a part of it (pause)	record baseline (about 2 min.)
2. Have S imagine he is sitting at his desk in the dorm, preparing to study for _____(fill in)--- Ask S to signal (depress button) when the image is developed-- Say, you have a quiz in _____ tomorrow and you are beginning to study for it (pause)	Record continuously Insert course name Reinforce slow click rate (e.g. 4.00 or lower (corrected) for 64 sec.
3. Think about the quiz--- You are having problems preparing for it---your mind blocks (pause)---- you cannot seem to concentrate (if S feels extremely anxious-- to an unbearable level---- have him press the button, then tell him to turn off the image; otherwise continue.)	Record continuously

4. You start to panic----- but you notice it instantly so you take a deep breath and say to yourself, "I am getting relaxed. I feel relaxed and my head feels cool and calm". (Repeat)	Record continuously point out feedback if clicks slow down
5. Stay with the image and feel yourself relaxing (pause) Now notice your mind start to open and you begin to think clearly---- the answers to your questions are coming (pause) you feel good	reinforce good relaxation
6. Switch off the image---- just feel yourself drifting, getting deeply relaxed--- feeling good---enjoying your relaxation (pause)	64 sec.
7. Now, imagine you are in the _____(fill in) class and the quiz is being distributed. Signal when you have the image (pause)	

8. Really see and feel yourself reading the questions--(pause)----and feel pleased and good that you can answer all of the questions---(pause) Notice how relaxed your neck and jaw are----and how good you feel all over. Focus on that relaxed feeling. (pause)

9. If time permits, re-do 2-4 above

10. Standard ending

End baseline

END OF SESSION

AD-A042 920 FRANK J SEILER RESEARCH LAB UNITED STATES AIR FORCE --ETC F/G 5/10
THE USE OF BIOFEEDBACK IN ANXIETY MANAGEMENT TRAINING AND ITS E--ETC(U)
APR 77 R G EGGLESTON, K E PARKER

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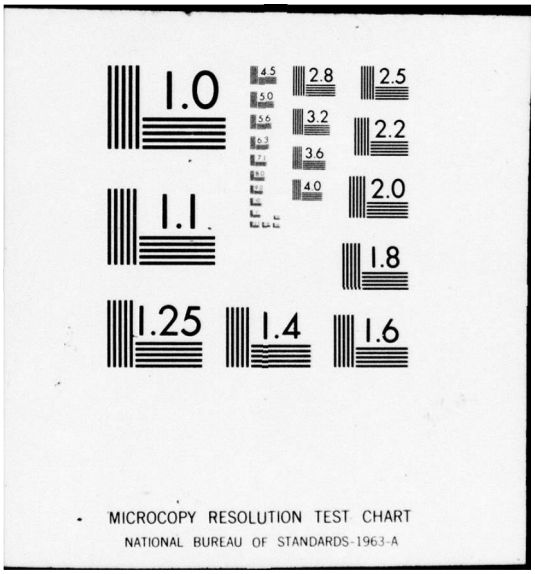
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SESSION 8: Stress Management

Start this session by not providing auditory feedback to the S. However, if S has problems identifying when he is relaxed, give him feedback until he improves. Have him note again what this relaxed sensation feels like. Try not to use the feedback more than necessary.

Say to Subject	Notice
1. Standard beginning---- deep breath----relax--etc.	record baseline (about 2 min.)
2. Have S imagine he is in _____ class and today is G.R. day (have S signal when he has the image).	record continuously
3. The test starts out well-- the first few questions are easy-----you are sure of your answers. Notice how relaxed you feel---(pause) Signal (press button) when you feel most relaxed (pause)	reinforce accordingly -- also, if relaxation is way substandard, give S auditory feedback and advise him you are doing so. Take it away when the clicks have shown a clear drop.
4. Now the next question is more difficult, you cannot think of the answer--- You start to get tense---(pause)	Stop image if tension is too high -- determined by Ss signal

5.	Now suddenly notice the tension ---feel it in your shoulders, your neck, and your face--- (pause)---Take a deep breath and feel yourself begin to relax and say, I am relaxed, my mind is clear an calm (repeat)---- pause	
6.	Have S signal when he feels most relaxed	Give feedback (verbally); if relaxation is substandard, give auditory feedback.
7.	Now completely let go--- Switch off the image and think only pleasant thoughts-- feel relaxed and at peace---	64 secs.
8.	Re-establish the test scene-- feel the tension starting to rise (pause) but now feel your head staying clear as you feel calm all over and say, "I feel calm and relaxed"(repeat).	Record continuously
9.	See yourself having difficulty on a question---the answer just will not come---pause--but you feel relaxed, and say, "I feel calm and relaxed" (pause).	Verbally reinforce

Now the answer is coming to you--
You feel refreshed and ready to
go on to the next question----

10. Switch off this image----
let your mind go blank----
completely relax-----enjoy
the moment-----feel good

End baseline

END OF SESSION

SESSION 9: Integration

This is the final formal biofeedback training session. The purpose of this session is to help the S in applying his biofeedback training to his entire life. Since he will not normally have an EMG device to monitor his tension, we will take away his feedback for this lesson. Do not at any time give him real time biofeedback information. Reinforce his performance with verbal statements only. After the session is over, discuss the importance of consciously using this training in his every day life. Encourage him to actively look for tension, to feel it, and to reduce it upon demand. Finally, have each S return one more time at the normally scheduled class hour so that we can administer the post test measures.

Say to Subject	Notice
1. Standard Introduction	Record baseline (about 2 min.)
2. You have a G.R. today in _____ (fill in). Picture yourself entering the class room----feeling confident---ready to take the G.R.	Record continuously
3. You have arrived early so you go over your notes to prepare yourself mentally for the G.R.--Now the G.R. begins (pause) and you feel relaxed. Signal when you feel very relaxed.	
4. Question #4 is difficult--- You cannot think of the answer-- Tension starts to build---- but you notice it and begin to relax immediately---- You take a deep breathe and say, "I am relaxed. My head is cool and calm"-----	Verbally reinforce

5. OK, switch off that scene -----blank your mind(pause)	30 sec.
6. Now I want you to imagine you are playing intermural basketball-----Signal when you have the image----OK, the game is close, only 4 pts. separate the two teams and the pace has picked up.	
7. Your team drops behind by 6 pts. and you feel yourself starting to press----- trying too hard and the tension mounts (pause) ---- Now take a deep breath and relax (pause) Signal when you are relaxed.	Reinforce
8. Switch off this image and relax----- just enjoy yourelf (pause)	30 - 40 seconds

9.	Now I want you to switch on another scene. Picture yourself in M.T. and you are next in line to make a speech--- feel the tension build as your turn comes closer-----and closer---- (pause)	
10.	Notice the tension and now release it! Take a deep breath and let your body relax----- feel good-- Signal when you are relaxed.	
11.	OK, now see yourself standing in front of the class making your speech. You feel confident--- it is really going well---- and you notice how relaxed you feel--it's a good feeling(pause)	
12.	OK, switch off this scene and relax-----	30-45 sec.
13.	Standard ending	End baseline

APPENDIX B

STUDY HABITS DEVELOPMENT PROGRAM

(Including data collection forms)

BFIS 75 STUDY PROGRAM

Lesson 1

Effective study is based on 1) a motivation to achieve, 2) reading flexibility, 3) the ability to organize study material, and 4) the ability to arrange the situation to receive rewards for your effort. If you are not willing to work hard, this program or any other program, will not help you achieve academic success. Therefore, if you are not prepared to give concentrated effort, you might as well stop reading and throw this away, for what follows can help you realize academic success only if you are willing to do the work.

Before reading flexibility, organization, and a reward structure can be put to best advantage, you must first determine how much time is already being devoted to effective study. If you are studying a lot, then your major effort must be devoted to improving your efficiency. On the other hand, if your present study schedule is limited, you must develop a reward structure sufficient to encourage you to study more. To determine present study time, the first thing to do is to set a clock aside to be used only to keep track of your study time. First, set the clock for 12 o'clock when you sit down to study and let it run until your mind drifts off the study material, or until you are interrupted, or stop studying to switch study material. If you have an electric clock, unplug it when your studying is no longer effective, and write down the amount of time you spent studying, indicating the material involved (i.e. Aero 331, Pol Sci 211, etc.). Each day record on the attached collection sheet the amount of time by subject you actually devoted to

study. If you are using a spring wound clock, record the amount of study time each time you stop and then reset the clock to 12 o'clock when you start to study again. Remember, count only time you spend actually studying. The provided data sheet allows you to see how much time you study from day to day. Generally, most people do not study nearly as much as they thought. With this knowledge, you can realistically determine how much of your problem is due to the simple fact the you are not spending enough time studying.

It is important to chart your study time from week to week. This chart will let you know in no uncertain terms when you are putting in the required time to achieve academic success. After you determine where you stand with respect to study time, you need to gain some rewards for your efforts. Up to now, you have not been getting much reward in terms of success on G.R.'s. If anything, you probably have been feeling punished for your efforts. That is, even though you put in a lot of time studying for a test, you have not been rewarded with a good grade on the exam. Even by following this study program, you are not going to have instantaneous success on all of your exams. Therefore, at least at the beginning, you will need to look else where for rewards for studying. The best way to start is to set up some short term goals which you can accomplish. Think positively about your effort and allow yourself to feel good about what you have accomplished, even if it is not as much as you believe it "should" be.

Almost anything can be used as a reward for studying. You can reward yourself with a coke break, an opportunity to call a friend, by reading the newspaper or a magazine article, or by doing anything else you really

want to do. The best way to establish rewards for studying is to do the following: First select the assignment you have to work on. Work on that assignment either until it is completed or until your mind starts to wander, you become fidgety and lose concentration. As soon as you notice your concentration slipping, STOP WORK. Ask your self, "What would I like to be doing right now?" If your answer is something that is possible to do now (e.g. play a game of foosball, write a letter, do squadron work, rest, etc.) then let that serve as your reward for work. Now, you must earn that reward. Set up a goal in terms of additional work to be accomplished. Really force yourself to complete some amount of work before you allow yourself to receive the desired reward. Initially, the additional work requirement that you establish should be quite small. For instance, reading to the end of the section in a text, or solving one or two more problems. Once you complete the work requirement that you have established, reward yourself by doing what you want.

You must be practical with your rewards. Obviously it would not be very productive if you were to spend an hour doing what you prefer and only 15 minutes studying. Therefore you must limit the amount of time you spend in non-study activities. It is recommended that you devote 50 minutes of each hour to study, and no more than 10 minutes to rewarding activity.

Allow yourself to really enjoy your well earned study breaks. This is important. If you continue to worry about unfinished work, or an upcoming exam, your study break will not be a rewarding experience. Try to clear your mind of all thoughts about academics and enjoy your break!

There are two more important aspects of this process of setting goals

and earning rewards. First, you must continue to demand more work to earn the desired reward. Slowly increase the amount of work that is required from, say, finishing a section (reading), to finishing an entire chapter, to finishing all required work for a particular lesson for a given course. Follow this procedure each day for each course. The only exception is, if you get to the point where you can complete all required work for a given day, then you may establish a reward that you get only after all of the day's work is completed. Obviously, when and if you get to this point, you can spend more than 10 minutes doing what you want.

The second thing you should do is keep a record of what you do on study breaks, how much time is spent in those activities, and whether you enjoyed it. The attached form provides a convenient method for collecting this information. Review this sheet periodically to determine if you are mentally getting away from academic work on your breaks. If you find that you are not successfully putting academics out of your mind, then you need to consider other things to do on your break which will more completely occupy your mind. By following all of the suggestions in this paper, you will have taken the important first step in improving your study habits. From this alone you will begin to see results! Additionally, you will be able to build upon these results by following other suggestions which will be presented in other lessons that you will receive later.

Now that you are setting up goals and getting rewarded for studying, you probably have noticed an increase in the amount of time you spend studying and that you are enjoying it more. But increasing time, by itself, does not make you efficient at studying. It is likely that your study efficiency can be improved. The purpose of this lesson is to provide you with information which will help you develop more efficient study habits. If you follow the suggestions herein, you will find that you will have more time to spend on material you are not completing now, or you will ahve additional time to spend on other, non-academic activities.

A number of factors affect work efficiency. One of the most important is related to where you study. You need to select a quiet place, where you don't do anything else except prepare your lessons. You can use the desk in your room, the library, an empty class room, the squadron study room, or any other suitable location. It is best to try and do all of your studying at this one place; however, if necessary, you can have both a primary and a secondary study area.

Once you have decided where you are going to study, reserve that area exclusively for studying. Do not do anything else there! The reason for this is that you want to establish a relationship between your selected study location and studying. Thus, everytime you go there, you will get yourself mentally prepared to study. It is just like seeing the basket-

ball court and feeling yourself getting mentally ready to play basketball. If you also use the basketball court for playing volleyball and badminton, however, seeing the basketball court may not cue you to start thinking about basketball, since that would be inappropriate much of the time. Rather, it may cue you to think about volley ball, if you play that there more than basketball. The same is true for studying. For instance, if you study at your desk, but you also use it when you read Sports Illustrated, or write letters home to a girlfriend, and occasionally lie your head down for a "short" nap, then, seeing your desk will not serve as a cue to begin studying. Indeed, it may cue you to become drowsy so that you feel the need to sleep! Thus, it is important that you set aside a place that is to be used only for studying.

If you find yourself starting to drift away from your studies, leave your study area immediately! This is the time to set your short time goals and to specifically identify what you would like to do. Then go back to your work area to work hard, recognizing that you will be rewarded with a break shortly.

Study efficiency also can be improved by applying appropriate organizational strategies. There are three major areas where organization is necessary: 1) determining the order in which you are going to study your courses, 2) determining the way you are going to study for each course, and 3) determining the best way to prepare for a test in each course.

Generally, you will be most alert earlier in the evening than later on. Therefore you should organize your study time so that any work which must be turned in the next day is accomplished first. After that, begin

preparing your lessons, starting with the course that is giving you the greatest difficulty. You probably dislike this course the most because you have been doing poorly on the GR's. Therefore, there is a tendency avoid anything related to this course, such as studying it! It is quite likely that at present you wait until everything else is done before preparing a lesson in this course, if you bother to prepare one at all. No doubt you are tired at this time, and the lesson never quite seems to get finished. Obviously, if you don't do the work, you will never improve in this course, whatever it may be. Thus, work on it first, when you are fresh, to be sure that it gets done. Also, since you will be more alert at this time, you will be able to pinpoint problem areas that can be

to avoid anything related to this course, such as studying it! It is quite likely that at present you wait until everything else is done before preparing a lesson in this course, if you bother to prepare one at all. No doubt you are tired at this time, and the lesson never seems to get finished. Obviously, if you don't do the work, you will never improve in this course, whatever it may be. Thus, work on it first, when you are fresh, to be sure that it gets done. Also, since you will be more alert at this time, you will be able to pinpoint problem areas that can be discussed with your instructor, instead of going to him with a general, vague feeling that you "don't understand anything going on in the course." Your instructor cannot help you very much if all you can tell him is that you don't understand the material, but don't know why or how.

There are a number of principles which you need to use when organizing your study material. The first thing to remember is that learning is an <u>active process</u>. You are not a sponge ready to soak up material.

You have to work at acquiring information. Thus, merely reading an assignment does not guarantee that you have learned much of the material. You must actively work with the material. The way to start is to survey the reading assignment to get a general idea about what it will cover. You should not spend more than a minute or two to complete this survey. The purpose for the survey is not to learn specific material, but to get you mentally prepared and thinking about the subject matter. Now, you are prepared to begin reading the material in earnest.

As you read an assignment, think about what you are reading. Ask questions, draw logical deductions, try to guess what is coming next. In essence, get mentally involved with the material. You will be surprised how often your questions will be answered by the author and how often your guesses will be correct and how well you will remember the material!

Taking notes or highlighting key points is also good to do. But there is a correct way and an incorrect way to do both of these things. Do not take notes or highlights while reading the first time. Wait until you have read at least a section or more and then go back to highlight or jot down notes. There are three reasons for this: First, you can focus on the key points better once you have synthesized the passage and thus you will not be as likely to highlight the same point two or three times as it was restated in different ways by the author. This will keep your highlighting to a minimal level. Second, after one complete reading, you are in a better position to summarize it in your own words. Third, if something is not clear from your reading, you can write a specific question about it to ask your instructor later.

It may appear that following the suggestions outlined above will be

too time consuming. I am certain that if you use them you will find them to be no more time consuming than your present study method; in some cases you will actually save time by using these suggestions, and you will be learning the material better in the process. This will be seen more clearly after reading Lesson 3.

All things considered, probably the most important point to remember about studying a reading assignment is that you should spend no more than 20-25% of your time reading the material. The remaining 75-80% of your time should be devoted to actively learning the materialand preparing for exams. Remember this maxim!

You must modify your organizational strategy to fit the demands of each course. For instance, if a course uses only objective tests like a multiple choice test, you need to study for recognition, not information recall. First you need to determine what kind of material is most likely to be tested and then concentrate time and effort on that material. You do not have to be able to reproduce this material, but you will have to be able to identify a correct statement about it when it is presented. You need to practice identifying the important material. This can be done by using study questions in the text or a work book, or you can construct your own recognition questions.

If a course uses essay exams of any type, you will need to study for recall of information. Generally, you will have to be able to recall general principles and concepts, and some supporting facts. Obviously, this means that you must learn a different kind of information than when you are studying for a recognition exam. Also, for recall, you must reproduce the desired information. To get ready for this, you must

practice writing answers to questions you make. Try to "second guess" the course director and write your own questions. If you cannot answer your own questions (actually writing our your answer), then you haven't learned the material. You need to go over it again. Learning does not occur without practice!

Courses that require solving problems, such as math or physics, must be handled in yet a different manner. These courses generally require learning basic principles or logic and then applying them. Frequently, further information cannot be understood without understanding the previously presented underlying principles. That is, new course material builds upon previous course material. Obviously it is necessary to learn the building blocks for the course. You should devote a lot of your time and active effort to this. After this material is learned, you must continually work problems to be sure that you can apply the information as required. If you understand a problem when it is explained by the instructor, do not assume it is "locked in" your mind. Solve a similar problem by yourself the same evening (check your next problem set!). This active involvement while the material is still fresh will help to permanently lock it into your mind.

If you fail to remember anything else from this lesson, at least remember that it is most important to get actively involved in the study process. How you get involved is dependent upon the type of material and how it will be tested.

Every student spends a great deal of his time reading. Therefore, being a proficient reader is of obvious importance in the development of effective study skills. The purpose of this lesson is to help you develop more efficient reading techniques.

Reading, as well as every other phase of studying, must be accomplished in an active manner. That is, you read for information. This means you must identify and conscientiously seek out the desired information. This requires both concentrated effort and prior knowledge about what information needs to be learned. By now you should have noticed an improvement in your ability to concentrate, since you are studying in a quiet place and you are rewarding yourself for your study effort. But have you been guiding your reading to efficiently prepare for each of your courses? Probably not. Let's look at a few principles that you should use to determine how to read a specific assignment in order to identify and learn the correct information.

First, regardless of the reading material, you need to survey it to prepare for what the author is going to talk about. This was mentioned in Lesson 2. Remember, don't spend too much time surveying the material, for all you are trying to do is focus attention on the material about to be read. The next step is to determine what you are reading for. That is, are you reading for significant facts,or for main ideas? This decision must be made before you begin to read an assignment. How this decision is made will be in part determined by the type of test that will be used to

assess your knowledge of the material. Clearly, it is necessary to read for specific facts if you are preparing for a multiple choice test or any other type of test requiring recognition of specific information. On the other hand, reading for main ideas would be more appropriate if you are preparing for an essay examination. In the latter case, it is necessary to stop at the end of a paragraph or section and ask yourself what is the main idea of the passage. Write the answer to this question in the margin of the text or in a note pad. But don't stop here. Continue by asking yourself, "What logic did the author use in arriving at this idea?" Record your answer and finally ask yourself, "What does the author use to support this idea?" By asking and answering these questions, you are actively processing your reading assignment, identifying and learning the important information.

Reading for significant facts or main ideas, requires the reader to change his point of focus accordingly. To insure that time is available to actively process what is being read, the reader must be able to adjust his reading rate. Since main idea information generally is found near the beginning and the end of a paragraph, you need to be sure that this information is captured. Therefore, read these areas of the paragraph at a comfortable rate. Don't drag, but do not push yourself to read excessively fast either. The remainder of the paragraph, however, should be read at a faster rate, one where you do push yourself. You should be searching for data which supports the main idea at this time. Focus on processing only the relevant supporting information. When you reach the next major idea, readjust your reading rate accordingly.

Reading at a constant rate is not efficient when reading for significant facts.

To increase reading efficiency, first determine what important facts need to be learned. Determine what facts are important by listening to what your instructor emphasized in class, by looking at the work book which accompany many text books, by reviewing questions provided at the end of a chapter in the text books, or by reading the course study guide. Use all available sources to help you identify what others consider to be the significant factors. Then, read the assigned material at a fairly rapid rate until you reach a sign post identifying one of these facts which you need to learn. Then, reduce your reading rate to a comfortable level. Be careful not to slow down too much (e.g. 150-200 words per minute), for research has shown that comprehension will actually be reduced if you read word by word, or nearly so.

The rate at which one reads material should also be determined by the type of material being read. Generally speaking, read technical scientific material somewhat slower than non technical material in order to maintain the same level of comprehension. This should be obvious. Technical material is more likely to include terms and expressions that are not familiar to you. This means that you need to learn the terms themselves before the material can be understood. Generally, this will not be necessary with non-technical material. Thus, reading physics, chemistry, engineering, mathematics, or even economics, will be a slower process than reading English, history, political science, or social science.

It was stated in Lesson 2 that no more than 20-25% of your study time should be spent reading an assignment. The remaining study time needs to be spent working with the material. To insure that time is

available to work with and process what has been read, you must become a flexible reader. You must pre-select what material is going to get the greatest attention and vary your reading rate accordingly. By following the suggestions contained here improved studying efficiency can be yours. All you need to do is some pre-planning and to get actively involved in studying.

As a student, it is often valuable to visualize the learning process as consisting of two parts: 1) the acquisition of information and 2) the retrieval of information. The first three lessons in this series focused primarily on what to do to improve your ability to acquire information. Many suggestions were made in these lessons which stressed how to arrange the study environment to facilitate the acquisition process. The key to becoming a good student is to envision yourself as an information processor, and as such to actively seek out the desired information to be learned and to actively work with this information. If you have been following the suggestions contained in these lessons, it is safe to assume that you are becoming more efficient and effective in capturing the information that is needed to achieve academic success. The necessary information is in the system, so to speak. Learning does not stop here, however. Now you must insure that this information stays in the system (you), and that it can be retrieved upon demand These two concerns are the focus of this lesson.

Everyone has had the experience on occasion of studying and finding it very easy to absorb the material. You just seemed to be mentally "into" the material, and everything made sense." In short, on this particular occasion, learning was easy!

This experience probably deluded you into thinking that you could answer any test questions covering this material. Indeed, had you been tested on the material immediately after it was read, you probably would have performed well on an exam; but beware! What would happen if you were not asked to recall this information until a day, week, a month, or

even two months later? Chances are you would not recall any more than 10% of the information. Research shows that it would even be less than that. Since one generally is not asked to recall "learned" information until quite some time after its initial acquisition, you probably have done poorly on an exam when you thought that "you really knew the material cold". This stems from the fact that once information is acquired, ones ability to recall this information deteriorates rapidly, within seconds, unless the information is consolidated in memory. Information cannot be recalled even a few hours after initial learning, even when it seemed "perfectly clear", if this material is not consolidated in memory. Consolidation is an important process.

Repetition is fundamental to memory consolidation. This means that when you are acquiring information, you must go over that information again and again. As has been indicated in previous lessons, this requires active processing of the desired information. This is why it is essential to determine beforehand what you want to learn. Then, you need to practice it.

Since newly acquired information rapidly leaks out of the system, the consolidation process must begin as soon after initial learning as possible. Thus, if you are to learn the material that has been diligently placed in your class notes, set time aside to process this information as soon after class as possible. This is particularly important when the material covered in class is highly technical and cannot be understood easily from reading a textbook, or else is not even covered in the reading material.

Summary of Main Points

1. Actively select and work with the material that needs to be learned. Spend 75-80% of your time in these activities.

2. Designate a study area that will be used only for studying.

3. When studying concentrate on the material and reward yourself for these efforts.

4. Organize study material by course and for the type of test you will take. This will facilitate retrieval of the desired information.

5. Be a flexible reader.

6. Practice retrieving the desired material.

7. Warm-up before a graded review.

8. Believe in yourself.

STUDY TIME LOG

Name ____________________ Dates ____________________

Course Title	Week	M	T	W	T	F	S	S	Time Totals: Goal	Time Totals: Actual	Test Scores: Possible	Test Scores: Mean	Grade
	1st												
	2nd												
	3rd												
	1st												
	2nd												
	3rd												
	1st												
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	3rd												
	1st												
	2nd												
	3rd												
	1st												
	2nd												
	3rd												

Hourly Totals — 1st week ________ 2nd week ________ 3rd week ________

STUDY BREAKS: ENJOYMENT RATING

DATE	SUBJECT (just completed)	STUDY BREAK (Activity)	How much did I enjoy my study break (7 hi- 1 lo)	How much did I think about academics? (1 - a little, 7 - a lot)